S. Hrg. 103–367

ADVANCED COMPUTING IN HEALTH CARE

ARING

FORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

AUGUST 5, 1993

Printed for the use of the Committee on Commerce, Science, and Transportation

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ADVANCED COMPUTING IN HEALTH CARE

THURSDAY, AUGUST 5, 1993

U.S. SENATE,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY,
AND SPACE COMMITTEE OF THE
COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The subcommittee met, pursuant to notice, at 10:15 a.m., in room SD–628, Dirksen Senate Office Building, Hon. John D. Rockefeller IV (chairman of the subcommittee) presiding.

Staff members assigned to this hearing: Patrick H. Windham, professional staff member; and Louis C. Whitsett, minority staff counsel.

OPENING STATEMENT OF SENATOR ROCKEFELLER

Senator ROCKEFELLER. I want to apologize for the lateness of one of the three Senators here, and say that I think this is a very exciting opportunity. I greet you all and I really think this subject is explosive in its potential. Not all positive, I might add. There is a certain irony in that Henry Waxman and I have just introduced a bill which says that basically if teaching hospitals are not producing physicians at a 50/50 generalist to specialist rate at the end of 5 years, $5.5 billion of Medicare money, which is obviously taxpayer money, will no longer be theirs.

And that is quite a rude shock for some folks around the country. Part of the reason for that imbalance is technology. The technology attracts specialists. Part of the problem of the country right now is the cost of healthcare, and part of the problem of the cost of healthcare is the cost of technology and the excitement of it, the under use of it, as well as, on the positive side, the glories and the possibilities of it all.

So, in any event, this is a subject which Senator Burns and I have long been interested in and cared about. This is a hearing we have long been looking forward to. My interest originally developed from my involvement in healthcare and healthcare reform, but this morning I look at this also as chairman of the Senate Science, Technology, and Space Subcommittee which is the committee that has the oversight of the Federal High Performance Computing and Communications Program, and which wrote the 1991 legislation formally establishing that program.

So, this morning, in addition to a general policy review which we hope will be offered and to which we will respond hopefully, we will examine three significant types of healthcare applications of advanced computing. The first is telemedicine, which allows health

professionals to communicate with each other. Conrad and I are thinking of that and also Ted Stevens, in terms of our very rural States and what that could mean. And I think we have pretty positive feelings about that. In other words, professionals communicating with each other and with patients.

In fact, with interactive two-way computer networks, the potential is enormous. A paramedic on the scene of an auto accident will be able to send video data, medical data straight to physicians at some distant hospital and receive recommendations straight back. That is technology which is good. A family practitioner in a small town in West Virginia or Montana or Alaska or anywhere else will be able to communicate directly with a regional hospital or, for that matter, with the Mayo Clinic.

The second application is medical data bases. Computerized records and retrieval systems which enable "authorized"—and that is an important word because that gets into the privacy issue—medical professionals to share patient information, or access medical libraries which can improve medical education and which can give ordinary citizens much better access to information about illnesses that they may have or illnesses which they worry about, and the procedures which might or might not accompany those illnesses. And the whole Wenberg Study at Dartmouth College comes immediately to mind. To do this at an enormous costsavings to the national healthcare budget.

Finally, advanced computing technologies also offer great potential to lower the heavy accounting and administrative costs that are afflicting American healthcare. Is it up to 20 percent? Who knows what the cost is. Whatever it is, it is several hundred billion dollars. Properly used, computers can be an important part of healthcare reform, lowering, not raising, costs, while maintaining high quality care.

So, today, from my point of view I want to ask two basic sets of questions of our witnesses. First, what are the opportunities and the associated benefits, as well as the costs and the policy issues? And then, second, how can the high-performance computing program and the new computer applications initiative contained in S. 4 help stimulate the development and use of these valuable technologies?

Now, we are very fortunate to have three distinguished panels. The first panel will present an overview of these healthcare applications and the current and potential future role of Federal programs in this area. Our witnesses are amazingly well qualified to speak on these matters. Dr. Don Lindberg wears, in fact, two hats: one, director of the National Library of Medicine, and second, coordinator of the high performance computing program. Ms. Marilyn Cade, who will speak on behalf of the National Healthcare Industry Consortium, is an AT&T executive who also has long experience in the healthcare field.

And second, we have three witnesses who will demonstrate some of these new applications, and I think that is why there are long lines outside. They are Dr. Julian Rosenman from the University of North Carolina Medical School; Dr. Eric Tangalos from the Mayo Medical School in Rochester, MN; and Marsha Radaj from the Wisconsin Health Information Network.

And the third panel will consist of three witnesses who will discuss innovative programs that already exist, particularly in—well, I was going to say two great, but three great States of interest to me and Senator Burns and Senator Ted Stevens. Mr. Chairman, your comments, please.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. This committee has a long history of encouraging the development of technologies which will help the Nation. Advanced computing is clearly one of the most important of these new technologies, and under Al Gore's leadership the Commerce Committee wrote the High-Performance Computing Act of 1991.

This year, S. 4, which I was pleased to introduce in January, contains a new Gore proposal that would move the Federal High-Performance Computing Program in an important new direction. Title VI of S. 4 would support research by computer users and vendors to develop trial applications through which advanced computing would help meet important national needs, including health care. We want to ensure that federally funded hardware and software is commercialized in ways which help the Nation as a whole.

This morning's hearing reflects not only the long interest that Senator Rockefeller, Senator Burns, and other Members have in health care. It also reflects this committee's continuing efforts to use research and technology to meet the economic and social needs of our country. This will be a valuable hearing, and I look forward to reviewing the testimony.

Thank you, Mr. Chairman.

Senator ROCKEFELLER. Thank you, Mr. Chairman. So, I thank all of you. I apologize profusely for my lateness, which is not excusable. And I turn now to my very very dear friend, Senator Conrad Burns from Montana.

OPENING STATEMENT OF SENATOR BURNS

Senator BURNS. Thank you, Mr. Chairman. I would just ask unanimous consent that my full statement be entered in the record.

Ever since my election to the Senate back in 1988, and when I came to this body in 1989, we have been working tirelessly for new applications for telecommunications technology. And I guess what pointed this whole thing out was this last July 4 when I was at home. My mom is 84 years old and she lives in rural Missouri, and when she can save $45 to $100 in office calls just plugging her pacemaker into the telephone, we see something happening to rural medicine to people who come from a time when they did not even have telephones.

And we see this technology and how it doubles and how it springs into action and how it can be used to help our people in rural areas. And let me tell you that Montana is rural. We have a lot of dirt between light bulbs out there. [Laughter.]

And we need to find some way to make sure that those people who live in those remote areas have access to the same medical healthcare and the same technologies as those who live in more urban areas.

So, Mr. Chairman, I thank you for holding these hearings. We are going to see several applications today. I do not want to take

up a lot of time and I do not think they are going to take up a lot of your time with a lot of testimony, but this is going to be a lot of show and tell today. There are things happening around this world that just absolutely will boggle the mind. And I think we are going to hear what is going to be expected of this Government and policymakers, to change some policy to allow it to happen on an accelerated basis to where the cost of the technology drops dramatically with use.

So, I thank you for your interest in this and I appreciate having these hearings and I want to thank each and every one of the witnesses that bring the case to the table today, and I thank you.

[The prepared statement of Senator Burns follows:]

PREPARED STATEMENT OF SENATOR BURNS

Mr. Chairman, thank you for agreeing to hold this critically important hearing on advanced computing in healthcare.

Today the Science and Technology Subcommittee takes an exciting glimpse into the future—the future of healthcare delivery in America and most importantly, rural America.

As I told you, Mr. Chairman, when suggesting this hearing, since my election to the U.S. Senate, I have been tirelessly and aggressively promoting the utilization of advanced telecommunications and computer technology in the delivery of rural healthcare.

When I first became involved in this issue several years ago, many of the things we will see and talk about today were just an idea. But when I went home to see my 84 year old mother over the Fourth of July recess, I found that my dream was becoming reality. My mother has a heart pacemaker. The week before I was home she had it checked over the telephone line.

Just think about this. A women who was born before there was telephone service in her part of the world, now has her pacemaker checked over the telephone.

Not only did my mother save the stress and danger of a 150 mile round trip to the doctor but it was $45 cheaper. A visit to a doctor cost her $90. It only costs $45 to have her pacemaker checked over the telephone.

This is what I mean when I say telemedicine will improve the quality of care for all Americans and reduce healthcare costs.

We in rural America—and Montana in particular—can and should be proud of the quality of healthcare which is currently delivered. Nevertheless, it is a simple fact of life that the very nature of the great plains and mountains is clearly an obstacle to rapidly accessing the information resources which are critically necessary to optimize the odds of survival of our family members, neighbors, and friends.

We are taking action in Montana and today we will here from Jim Reid about the Eastern Montana Telemedicine Project from Billings and Dr. Robert Flaherty with the Virtual Medical Center at Montana State University in Bozeman. But we must do more yet.

Mr. Chairman, I don't think that most of our colleagues here in the Congress truly understand the rural nature of a state like Montana, the frontier, what that means to the delivery of healthcare, and how important telecommunications and other advanced technologies can begin the delivery of those rural healthcare services—in fact, to the very survival of these communities.

The real tragedy of this whole situation is that the enabling technology to access critical healthcare diagnosis and information is available today at a reasonable cost. We will demonstrate that point quite clearly at today's hearing.

Unfortunately, in the face of the very serious healthcare problems which threaten the very fabric of our rural communities across this great land, the major stumbling block to the expansion of telemedicine technology to healthcare diagnosis and information is government policy—or more appropriately lack of clear and forward looking government policy.

Today, while demonstrating what is available here and now in the field of telemedicine, I will be looking to our distinguished group of witnesses—including two from my home state—to provide the Subcommittee with a listing of the government policy chances which are necessary to accelerate the use of telemedicine, especially in rural areas.

With that list of policy changes in hand, it is my hope, Mr. Chairman, that together, you and I can include, in the healthcare reform package, provisions which

will facilitate the utilization of advanced telemedicine technologies in the delivery of rural healthcare diagnosis and information.

Thank you again, Mr. Chairman. I very much look forward to working with you to ensure that rural Americans receive quality healthcare diagnosis and information through advanced telemedicine technologies in the future.

Senator ROCKEFELLER. Senator Stevens.

Senator STEVENS. No, I have no opening statement, Mr. Chairman.

Senator ROCKEFELLER. That is impossible. [Laughter.]

You have something wise to say. You always do.

Senator STEVENS. No. I was tempted to say that if he has many miles of dirt between light bulbs, that we have thousands of miles between the kerosene lamps that are frozen. [Laughter.]

But I am really here because I think it is a very interesting hearing that you have scheduled, and I just want to hear as much of it as I can. Thank you.

Senator ROCKEFELLER. Great. Thank you, sir.

Dr. Lindberg, we are very grateful to you, sir. You may proceed.

STATEMENT OF DONALD. A.B. LINDBERG, M.D., DIRECTOR, NATIONAL COORDINATION OFFICE FOR HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS

Dr. LINDBERG. Mr. Chairman, I am pleased to have the opportunity to describe some of the challenges that our——

Senator ROCKEFELLER. Pull that mike a little bit closer to you, would you, Dr. Lindberg.

Dr. LINDBERG. Yes, sir. Mr. Chairman and members of the committee, I am pleased to have the opportunity to describe some of the challenges that our Nation's healthcare providers face, and how computing and digital communications can help meet those challenges.

Senator ROCKEFELLER. Can everybody in the hearing room hear? I think you are going to have to really put your mouth up to the microphone.

Dr. LINDBERG. I wonder if this is working.

Senator ROCKEFELLER. It is working, but the people in the back cannot hear.

Dr. LINDBERG. Then we will give it some lung power.

Mr. Chairman and members of the committee, I am pleased to have the opportunity to describe to you some of the challenges that our Nation's healthcare providers face, and how computing and digital communications can help meet those challenges. I would like to endorse the remarks of the chairman, who described very beautifully most of the, or at least, many of the good possibilities for the use of computers and high performance computing and communications.

The original High Performance Computing and Communications Program of 1991 emphasized the development of new computer architectures and high-speed networks for the so-called grand challenges of science. At the National Institutes of Health, four organizations have HPCC programs and are therefore a part of that activity: the National Library of Medicine, the National Cancer Institute, the National Center for Research Resources, and the Division of Computer Research and Technology. And I should describe first to you briefly what kinds of activities those institutions support.

NCRR supports grand challenge teams that use the facilities of National Science Foundation supercomputer centers to solve key problems in biomedical research. Mathematical models and brain mapping are examples. NCRR also sponsors research in the use of virtual reality technology for healthcare.

DCRT has an intramural program that is developing several applications of massively parallel scalable computers for biomedical research, especially in the areas of modeling large chemical molecules and molecular dynamics.

The National Cancer Institute's supercomputer facility investigates the characteristics of DNA and other key molecules that are involved in the transformation of normal cells into cancerous cells.

The National Library of Medicine has been, so far, the PHS lead agency in high performance computing. Among a number of research projects related to HPCC are the following three I will mention just very briefly. The Unified Medical Language System is created to extend information retrieval for medical decisionmaking, using the Internet and the hundreds, really, of knowledge sources that are attached to the Internet. Second, we are creating data bases of digital human anatomic three dimensional data for national use. Third, there is a medical connections grant program to provide assistance to medical centers and hospitals who wish to connect to the Internet.

I should say too that we in the HPCC agencies wish to expand the number of health agencies that are involved in the program. And already the Centers for Disease Control, the Food and Drug Administration, the Agency for Health Care Policy and Research, and the Indian Health Service are now represented as guest members at the meetings of the HPCC Subcommittee of the FCCSET Coordinating Council. So, they have an opportunity to join up over the course of the next year or so, and we very much hope that they will be able to do that.

Now, I have already indicated that the original bill essentially focused on grand challenges and research. The S. 4 we endorse with great pleasure. This expands the focus of HPCC beyond biomedical research to healthcare delivery and, of course, its applications and its obligation to contribute toward the formation of the National Information Infrastructure. We think this is a very salubrious change.

In healthcare delivery remarkable advances in medical science and technologies over the past few years have brought dramatic changes. I would like to mention four ares which you can either consider problems or opportunities, depending on how one chooses to look at them. But in each of these four areas computing and high-speed communications offer real hope of sustained improvement in healthcare, and I think savings in dollars as well.

The first problem that all medical professionals face is that there is simply too much information to keep up with, too much to remember. The National Library of Medicine recognized this and many years ago created a computerized system for searching and retrieving from the medical literature. The system is called MEDLINE and it grows at the rate of some 400,000 new entries every year, representing articles published in over 4,000 biomedical journals in the U.S. and around the world. We essentially bring the

biomedical knowledge of the world to our country for the benefit of the public health.

But if we put it another way, in a personal way, if your doctor or personal physician were very very conscientious and every night before he or she went to sleep read two complete articles in his or her field, at the end of the year the doctor would be 800 years behind. You just cannot learn that way. You cannot keep up in that fashion. You have to have mechanized systems to keep up with the huge proliferation of biomedical literature. Naturally, every piece of the literature is not pertinent to every single patient, but we want whatever is pertinent to us individually when we see a doctor.

So, computerized data bases do help medical professionals—that is exactly what MEDLINE is all about—to find the answers when and where they need them. So, gratefully, the existing program does a good job, but it has deficits. It is not as fast as it will be when the full Internet is available across the country. It is not universally available as it will be when the National Information Infrastructure is really complete.

We cannot handle pictures. We know that lots of medicine is pictorial. As the chairman said, you want to send an x-ray of the patient, you want to send a photo of the patient. We cannot send entire documents as yet except through fax, through group 3 fax, and we do not connect seamlessly to the various knowledge sources that are available in Internet outside of National Library. Now, the more progressive medical schools emphasize the teaching of clinical problemsolving methods rather than just remembering facts, and inevitably these work through computers and accessing the knowledge base of medicine as it expands. The methods almost always involve the system.

As you know, the National Institutes of Health and the Department of Energy—you also oversee them—are pursuing the Human Genome Project jointly, and this is aimed at determining the 3 billion units of DNA that are the molecular blueprint for health and disease. The future of healthcare is clearly in this era of molecular medicine, where diagnosis and treatment will be guided by analysis of patterns of DNA which so far defy recognition by the unaided human eye and mind.

And for this, even our most powerful present generation supercomputers are slightly inadequate. We are barely keeping up. High-performance computing technologies provide the only feasible approach for discovering within the emerging fragments of the human genome those relationships that can cause abnormal growth or can cure disease.

The second area I would like to mention more briefly is a situation in which we are, in a sense, victims of partial success. As we look in hospitals, computers have been applied to managing the everyday affairs of hospital labs, x-ray departments, clinics, billing systems, but the systems do not really talk to one another, they are not integrated. Healthcare computers are generally linked only by oceans of paper printout.

There is a lack of clinical systems integration, and also a lack of standards. I think other speakers will inevitably have to mention standards for exchange of medical and administrative data between those systems and medical centers and the Government in any geo-

graphic region, and between medical centers and third-party payers.

The result of this for the individual doctor and the patient is the frustrating inefficiency of disorganized paper charts stuffed with computer-printed test results, and lost medical records. The result for the Nation is a vast effort spent manually transcribing and retyping medical data for clinical and administrative purposes. Lost patient records and inaccessible test results cause unnecessary duplication of diagnostic tests, and prescription of conflicting and inappropriate treatments.

We believe the answer to these and many other healthcare management and public policy problems is to perfect the computer-based patient record. And, indeed, this is well specified—pointed to anyway, I guess I should say, as the sixth element in the healthcare provisions of S. 4. A very central issue that is carefully identified. We applaud that.

The third challenge that confronts us is that unusual diseases occur everywhere, but health professionals with highly specialized skills in unusual diseases are clustered in major metropolitan medical centers. The chairman pointed out that collaborative arrangements for treating patients at a distance are critical, both for rural areas and really for the whole country. For those who live in rural areas far from major medical centers, travel and family dislocation during serious illness multiplies the burden of suffering and increases unreimbursed medical expenses to families. Realtors are fond of saying that the important three qualities of a piece of property are location, location, location, but the same observation often applies to healthcare as well.

I should say to Senator Burns that I spent 24 years in Missouri and I know the healthcare system and the good people of the State very well, and hope that your mom is getting good care. If not, let me know. [Laughter.]

Senator BURNS. You might get a letter tomorrow.

Dr. LINDBERG. The fourth and last area where computing and networking are rapidly changing healthcare is in the area of clinical images, and this too is identified in your bill. Pictures are not new to healthcare; x-rays have been used for well over 100 years based on photographic film. But now filmless digital radiology is feasible and being routinely used in some centers. In addition, computer-based imaging—computed tomography, magnetic resonance imaging, positron emission tomography—all these now provide unprecedented ability to look inside the body. These pictures are derived from digital signals from the start. A picture may be worth a thousand words, but in this case a single clinical image may also require millions of bytes of data, and the challenge in making these clinical images available wherever they may be needed is that high-speed, wide area networks are an essential technology.

In a way one could say that it is easier and cheaper to send the picture than it is to send the patient. In that connection, I should point out that during the recent gulf war temporary computer communications services were established between Kuwait and Saudi Arabia and Washington. Among the numerous uses to which these were put was sending medical images of injured and sick personnel under U.S. and allied care. This worked quite well.

Mr. Chairman, I submit that if we can mobilize "collaborative arrangements"—I am quoting from your bill—"collaborative arrangements for treating patients at a distance" in the case of the Persian Gulf, it does seem reasonable to press on to test these ideas in the United States.

With that in mind, the National Library of Medicine, acting as part of the High Performance Computer Program, issued a broad agency announcement. We essentially took the initiative while your bill was being considered and we made a request for research proposals which reflected exactly the six medical and healthcare applications in S. 4. We just simply quoted them from the legislation.

The response has been quite dramatic. Over 120 applications have been received from universities, research labs, commercial computing and communications companies, medical professional societies, and community hospitals. These are from 33 States plus the District of Columbia.

Most of the proposed research is built on multidisciplinary teams of physicians, information professionals such as medical librarians, computer scientists, and also engineers and business managers. These, of course, are still under evaluation, so I cannot tell you the results exactly, but they are quite good quality, and I am sure at least the normal percentage of 20 or 25 percent NIH funding capability will emerge, and all parts of the country in our view are ready to get on with this project, so we earnestly thank you for your support and applaud the guidance and the leadership the committee has given the country.

Thank you for the opportunity to be with you.

[The prepared statement of Dr. Lindberg follows:]

PREPARED STATEMENT OF DONALD A.B. LINDBERG, M.D.

I am pleased to have the opportunity to describe some of the challenges that our nation's healthcare providers face, and how computing and digital communications can help meet those challenges.

S. 4 proposes new activities to supplement the existing High Performance Computing and Communications (HPCC) program which began in 1991. The original HPCC program emphasized the development of new computer architectures and high speed networks for the "Grand Challenges" of science.

At the National Institutes of Health, there are four organizations with HPCC programs: the National Library of Medicine (NLM), the National Cancer Institute (NCI), the National Center for Research Resources (NCRR), and the Division of Computer Research and Technology (DCRT).

Although the NIH programs are wide-ranging, I might mention several highlights. The NCRR sponsors Grand Challenge Teams that use the facilities of NSF Supercomputer Centers to solve key problems in biomedical research. NCRR also sponsors research in the use of virtual reality technology for healthcare. The DCRT has an intramural team pioneering the development of several applications of massively parallel scalable computers for biomedical research and clinical medicine, including medical image processing, database searching, x-ray crystallography, multidimensional NMR spectroscopy, gene linkage analysis, molecular dynamics, quantum mechanics, drug design and electron microscopy. The NCI's supercomputer facility investigates the characteristics of DNA and other key molecules that are involved in the transformation of normal cells into cancerous cells. Among a number of HPCC-related programs at NLM is the Unified Medical Language System for aiding information retrieval, the creation of databases of medical images for research and education, and a Medical Connections grant program to provide assistance to medical centers who wish to connect to the National Research and Education Network.

We wish to expand the number of health agencies involved in the HPCC program. Already the Centers for Disease Control and Prevention, the Food and Drug Administration, and the Indian Health Service are now represented as guest members at

meetings of the subcommittee of the Federal Coordinating Council for Science, Engineering and Technology that oversees the HPCC program.

S. 4 expands the focus of HPCC beyond biomedical research to healthcare delivery, where remarkable advances in medical science and technologies over the past several decades have wrought dramatic changes. Some of those changes are exhilarating, with a promise of new ways to prevent and cure diseases, and some of those changes are overwhelming and frustrating to patients and providers alike. I would like to mention tour areas which are either problems or opportunities, depending upon how you choose to look at them. In each of these four areas computing and high speed communications offers hope of real and sustained improvement in healthcare.

The first problem that all medical professionals face is that there is simply too much information to keep up with, too much to remember. The National Library of Medicine recognized this and created a computerized system for searching the medical literature over a quarter of a century ago. That system, called MEDLINE, is now growing at the rate of over 400,000 new entries per year, representing articles published in over 4000 biomedical journals around the world. Put another way, if your doctor were extremely conscientious and read two journal articles every night, at the end of a year your doctor would be roughly 800 years behind. Computerized databases help medical professionals to find the answers they need when they are needed. We are in a transition in the way that doctors and other health providers are educated. Unfortunately, it is still the case that many medical students are trained largely by memorizing "facts" which will be discovered to be fiction at some time in the future. More progressive medical schools emphasize the teaching of clinical problem solving methods which will continue to work even though the knowledge base of medicine changes and expands. Those methods virtually always involve use of computers to search medical databases for the latest findings for diagnosis and treatment. As you know, the National Institutes of Health and the Department of Energy are pursuing the Human Genome Project, to determine the three billion units of DNA which are the molecular blueprint of health and disease. The future of healthcare is clearly in the era of "molecular medicine", where diagnosis and treatment will be guided by analysis of patterns of DNA which defy recognition by unaided human eye and mind. And for this, even our most powerful present-generation supercomputers are scarcely adequate. High performance computing technologies provide the only feasible approach for discovering within the emerging fragments of the human genome those relationships that can cause abnormal growth or can cure disease.

The second area I would like to mention is a situation where we are victims of a partial success. Though computers have been applied to managing the everyday affairs of hospital laboratories, x-ray departments, clinics, and billing systems, those systems as a rule do not "talk" to one another. Health care computers are generally linked only by oceans of paper printout. There is a lack of clinical systems integration, and a lack of standards for exchange of medical and administrative data among systems within a medical center, between medical centers in any geographic region, and among medical centers and third party payers. The result of this for the individual doctor is the frustrating inefficiency of disorganized paper charts stuffed with computer-printed test results, and lost medical records. The result for the nation is a vast effort spent manually transcribing and retyping medical data for clinical and administrative purposes. Lost patient records and inaccessible test results cause unnecessary duplication of diagnostic tests, and prescription of conflicting and inappropriate treatments. We believe the answer to these and many other healthcare management and public policy problems is to perfect the computer-based patient record. Indeed, this is the sixth element of the healthcare provisions of S. 4.

The third challenge that confronts us is that unusual diseases occur everywhere; but health professionals with highly specialized skills in unusual diseases are clustered in major metropolitan medical centers. It really does make a difference in our country where you happen to be when you become sick or injured. For those who live in rural areas far from major medical centers, travel and family dislocation during serious illnesses multiplies the burden of suffering, and increases unreimbursed medical expenses to families. Realtors are fond of saying that the most important three qualities about a piece of property are location, location, location, but this same observation often applies to healthcare as well.

The fourth and last area where computing and networks are rapidly changing healthcare is in the area of clinical images. Pictures are not new to healthcare—x-rays have been used for over 100 years based on photographic film, but filmless digital radiology is now feasible and being used routinely in some centers. In addition, computer-based imaging such as Computed Tomography, Magnetic Resonance

Imaging, and Positron Emission Tomography now provide unprecedented ability to look inside the body; these pictures are derived from digital signals from the start. A picture may be worth a thousand words but in this case a single clinical image may also require millions of bytes of data, and the challenge in making these clinical images available wherever they may be needed is that high speed, wide area networks are an essential technology.

The healthcare provisions of S. 4 directly address these challenges and problems. As you know, the legislation includes these areas for research and development:

- Testbed networks to enable healthcare providers and researchers to share medical data and images;
- Visualization technology for clinical images;
- "Virtual reality" technology for simulating operations;
- Collaborative technology to allow several healthcare providers in rural and other remote locations to provide real-time treatment to patients;
- Database technology to provide healthcare providers with access to relevant medical information and literature; and
- Database technology for computerized patient records.

Is the time right for an investment in research and development in these areas? Is there sufficient interest and expertise to make real progress in these areas? I believe we have the answer to those questions in hand. Earlier this year, as S. 4 was introduced into the legislative process, the National Library of Medicine took the initiative to publish a Broad Agency Announcement for biomedical applications of High Performance Computing and Communications. That request for proposals reflecting quite specifically the medical applications areas of S. 4. The response has been dramatic. Over 120 applications have been received from universities, research labs, commercial computing and communications companies, medical professional societies and community hospitals from 33 states and the District of Columbia. Most of the proposed research is built upon multi-disciplinary teams of physicians, information professionals such as medical librarians, computer scientists, engineers, and business managers. The project proposals are at this moment undergoing peer review by panels of technical experts drawn from universities, government and industry.

All of the medical applications areas mentioned in S. 4 are appropriate and well chosen. Of course, there are other applications areas that are now or may prove in the future to be equally important. I think that it is essential that S. 4 not somehow inadvertently limit our ability to explore these other areas as well.

The first of the areas, listed the creation of testbed networks, is first in our minds as well as the highest priority. This is because many of the known problems and obstacles to full utilization of computers and information systems in medicine and healthcare seem not to be subject primarily to theoretical—or even technical—analysis. Rather, they seem to fall in the domain of the practical and the pragmatic. That is, we need the opportunity to gain experience with working but still "model" or provisional systems. The diversity of the regions and states within our country itself seem to suggest that local experimentation might usefully precede the countrywide deployment of an information system.

Let me give as an example of the potential usefulness of testbed networks the questions which abound concerning privacy and medical records, especially medical records that are subject to computer network transmission, storage, and retrieval. At present we know considerably more about how to encipher computer records in general than we know about the exact requirements in a medical care situation. Testbed computer networks within the setting of healthcare institutions and using actual patients will provide the practical experience to illuminate dilemmas such as the privacy problem.

Let me give you another very current example. Yesterday, the Centers for Disease Control and Prevention (CDC) sent out a team of program and computer experts to set up an emergency communications network in the flood-stricken State of Iowa. They hope to tie together a number of midwest states with disease experts at CDC.

The S. 4 provisions dealing with images likewise are a high priority with the HPCC agencies. The new high-speed networks—if made available to physicians and healthcare institutions—will unquestionably be tried out in applications where medical images are important to patient care and medical decision making. It isn't difficult to think of a host of such cases. We have all seen medical x-ray films. Nowadays many patients and families are used to seeing the much more complex images that result from CAT-scanning and magnetic resonance imagery. In the simplest possible terms, it is often easier and more sensible to move these images—for example, to a remote expert consultant—than it is to move the patient.

During the recent Gulf War, for example, temporary computer communications services were established between Kuwait and Saudi Arabia and Washington, DC.

Among the numerous uses to which these were put was sending medical images of injured and sick personnel under U.S. and allied care. Mr. Chairman, if we can mobilize such a "collaborative arrangement for treating patients at a distance", in the case of the Persian Gulf, it does seem reasonable to press on to test the same ideas within the United States.

In this connection, the Indian Health Service bears special note, for this arm of the U.S. Public Health Service serves several million native Americans through a sparse collection of small healthcare facilities scattered in rugged, rural parts of America. The effect on the quality of healthcare in rural and remote areas would indeed be dramatic if a remote expert consultant were available for on-the-spot diagnosis and treatment.

In summary, I believe that it is clear that we have a timely combination of a real need in healthcare, and maturing computing and communications technologies which can plausibly meet that need. The healthcare provisions of S. 4 are a dose of the right medicine for improving the health of America's healthcare system.

Senator ROCKEFELLER. Thank you, Dr. Lindberg. Ms. Cade. We usually, incidentally, operate on a 5-minute rule around here, but we are not so far. In other words, all of your testimony is in the record, so there is no kind of biblical requirement to repeat all of it.

STATEMENT OF MARILYN S. CADE, DIRECTOR, TECHNOLOGY/INFRASTRUCTURE, COMPUTER PRODUCTS AND SERVICES, AT&T GOVERNMENT AFFAIRS, REPRESENTING THE NATIONAL HEALTHCARE INDUSTRY; ACCOMPANIED BY JOE SULLIVAN, PRESIDENT, AMERITECH HEALTH CONNECTIONS, AND JACK McGUIRE, VICE PRESIDENT, BUSINESS DEVELOPMENT, SCIENCE APPLICATIONS INTERNATIONAL CORP.

Ms. CADE. Thank you, Mr. Chairman and members of the subcommittee, for the opportunity to testify today. Today, I am testifying on behalf of the National Health Care Industry Consortium, an emerging consortium of leading healthcare technology firms.

Here today with me also are two additional members of our emerging consortium, Joe Sullivan, the president of Ameritech Health Connections, and Jack McGuire, vice president of business development at SAIC, the Science Applications International Corp.

On the slide here I have shown the membership and the organizing principles and also the participants of our consortium. On the right is shown a list of the regional alliances that we are working to affiliate ourselves with.

[A slide was shown.]

Ms. CADE. I will come back and answer questions about the list of members later, if we have further questions about that, but I want to make the point that in addition to leading healthcare information providers that we have a very broad participation in our consortium of insurance companies, business providers, communications companies, computer systems providers, information integraters, and information applications providers.

Our intent is to link those entities with the 14 regional healthcare alliances. Today, I will describe very briefly a project that we are undertaking which we think will contribute to improving the role that information technology plays in lowering the cost of delivering healthcare and improving the access to healthcare.

Our intent to do that is based on the view that an advanced information infrastructure can help to improve healthcare delivery. We intend to develop a model architecture that will be usable

across diverse and disparate systems to develop and institute standards and tools so that users of a system located in one hospital will be able to collaborate with doctors on a system located in another hospital, and so that users will be able to exchange information effectively across these different systems.

We also think of critical importance is the need to accelerate the speed with which this improved healthcare information technology is deployed across our country. Let me characterize how NHIC sees the problem, in very similar terms to the way that you articulated it and the same way that Dr. Lindberg articulated it.

Health care is an extremely complex system. Reams of information are collected every day in different locations, largely in manual form, rarely in digital form, at the point of contact with the patient or the point of actually making a decision. Although many hospital management processes are automated today, as I said, that is not done in digital form at the point of encounter, so the ability to take that information and ship it electronically is still very, very limited.

I do not have to remind the subcommittee or the members of the audience today that healthcare is not getting simpler. In fact, it is probably getting more complex and more challenging. My written testimony submitted for the record describes further how NHIC's members are already applying today's versions of available technology to try to address these problems in rural and urban settings across our country.

But we believe we are only at the threshold of beginning to apply these technologies and understanding how the emerging technologies can help care-givers improve the quality of the decisions that they make. What is needed is a healthcare information infrastructure.

The Computer Systems Policy Project, a well-known leadership organization of the CEO's of 13 leading U.S. computer companies, have also addressed this concept. Their recent white paper, "Information Technology's Contribution to Health Care Reform," describes how the infrastructure can help to address problems of quality, cost, and access, and calls for demonstration projects.

This open environment envisioned by CSPP and our members must be able to accommodate today's systems so that hospitals and doctors do not lose the investment they have made in information applications but are able to easily add in the new applications and technology, such as handheld devices, voice recognition and input, which will make it much easier for a doctor to do an examination and actually record the results of that examination there on the spot, with the patient, such as the ability to allow handwriting input to a computer at that very point, instead of having someone take notes and then transcribe them, and such as easy-to-use portable, affordable video conferencing, so that doctor-to-doctor and doctor-to-patient consultation can take place across those distances that Senator Burns was describing so clearly.

We believe that Government and private sector collaboration is essential to address these challenges that are still before us. Government can play an important role in spurring precompetitive research and development in some of the remaining challenges in critical technologies.

Government can also speed the integration of this technology working with industry to sponsor demonstrations that utilize this advanced computing and communications capability and ensuring that the benefits that we gain from these collaborative efforts are spread as quickly as possible across the rest of industry.

As you know and have stated, there are projects very similarly financed and managed, such as the high performance computing and communications initiative, and the efforts that are proposed under S. 4. Consistent with these efforts, the Advanced Research Projects Agency of the DOD has proposed a technology reinvestment program with a section that focuses on healthcare information systems.

Our consortium came together to develop a response to this proposal. ARPA essentially acted as a catalyst, drawing together our group of industry leaders already deeply involved in applying advanced technology and applications. Through our proposal, we will involve our own companies and the numerous regional alliances shown here in an effort to change how information technology is used to better manage healthcare information systems.

We plan to develop an information architecture, across a wide breadth of healthcare domains to develop and introduce those new tools and utilities that are needed to test the effectiveness of these systems with real doctors, real nurses, real laboratory technicians, and with real patients, to make sure that the systems that are devised are easy to use and are very effective in improving the quality of the clinical and management decisions made.

The ultimate measure of success will be the more effective application of the advanced computing and communications technology in improving the quality of healthcare of our country and lowering the cost. We ask that you continue to support legislation that will promote the kind of Government-industry partnering just mentioned, and that will encourage the development of this healthcare information model consistent with the national information infrastructure.

We feel that we are moving toward a new information management paradigm. We believe that our country must move ahead quickly to maximize the use of information technology as a tool moving toward an open, available, affordable, easy-to-use and standards-based environment, an environment that allows consumers, doctors, and nurses, wherever they are in our Nation, to have easy and immediate access to the kind of information that helps them make more informed decisions.

I will be happy to answer any questions. Thank you.

[The prepared statement of Ms. Cade follows:]

Prepared Statement of Marilyn Cade

Mr. Chairman and Members of the Subcommittee, my name is Marilyn Cade. I am Director, Technology/Infrastructure, Computer Products and Services, AT&T Government Affairs. Today, however, I am testifying on behalf of the National Healthcare Industry Consortium (NHIC), an emerging consortium of leading healthcare information management firms, working in collaboration with innovative healthcare providers, employers, governments and other parties in 14 communities and states across the country. These communities and the NHIC firms have come together to begin to define a new national healthcare information infrastructure, which will support a new approach to how information is gathered, managed, and utilized throughout the healthcare system.

My testimony will describe the fundamental importance of information access in empowering both the consumers and the providers of healthcare to improve the quality of healthcare and reduce its costs. In response to the subcommittee's questions, I will also review some of the existing work our members are doing in applying advanced computing applications to these very challenges. Finally, I will also describe briefly the project our consortium is undertaking, and our general recommendations for taking full advantage of the benefits high performance computing can have in the healthcare industry.

THE NEED FOR CHANGE

As we prepare to enter the 21st century, the delivery and management of healthcare is a significant challenge to both industry and government. Healthcare costs already represent nearly 14 percent of the GNP, and are expected to reach one trillion dollars early in the next decade. Quality of care and access to care remain substantial concerns, in spite of the amount we spend on healthcare.

We also lack the information that would help us to more clearly know where we can gain greater benefits from spending our healthcare resources. Because of the difficulty millions of doctors, nurses and other healthcare professionals face every day in quickly gaining access to the information they need to care for their patients, we squander the most valuable resources we have in our healthcare system, our human resources, while needlessly driving up costs. The limited state of knowledge and limited access to information by many of our citizens contributes to large amounts of avoidable acute and chronic health problems, and substantial overuse of high cost emergency treatment for non-critical healthcare needs.

And perhaps most importantly, all of us citizens remain in the dark about the relative cost and quality performance of our healthcare service providers because the data that would help us to be more informed are so very difficult to obtain given the current state of healthcare information systems across our communities.

This is not to say that many segments of our healthcare delivery system are not world class—they are. But overall, the practice of healthcare and its administration are seriously in need of advancement to improve on the value we all receive from the large amount of resources we spend.

These inadequacies have been recognized, and our healthcare information systems are rapidly being restructured. It is also recognized that there is no single solution or easy set of answers; rather we face a set of extremely complex challenges which will require the attention and cooperation of government policy makers, healthcare practitioners, employers and insurers, providers of information systems, and consumers, for years to come.

THE STATE OF HEALTHCARE INFORMATION TECHNOLOGY

Many efforts to improve the value of healthcare delivery today remain dramatically limited by the reality that clinical information about a patient, and/or the latest medical knowledge are not available to a doctor, nurse, health insurer, or administrative agency when critical decisions must be made to proceed with care.

Although many hospital departments' information management processes are automated today, a substantial portion are still unable to communicate with departments down the hall, and the vast majority are unable to link with their doctors' offices across the street, or with the laboratories, pharmacies, and insurance companies across town. These limitations are even more dramatic when viewed from the perspective of the physician in his/her office who is the very person who drives all the critical decisions on how our healthcare dollars are spent.

Much of the data that are gathered are not in a digital form that can be easily manipulated. Highly trained professionals rely on handwritten notes, scattered in a thick file folder of records taken by different doctors and nurses, often in different formats. Test results are often not immediately available—so tests get repeated. It is estimated that doctors and nurses spend close to 40 percent of their time on paperwork, much of it spent looking for critical pieces of information. Thus do we squander our most valuable healthcare resources.

This lack of effective automation and integration of information systems across the healthcare industry creates inefficiencies, drives up costs, greatly reduces healthcare providers' ability to use information to provide better care, and leaves patients as uniformed consumers. Often it can even be dangerous for the patient when, for example, the physician—based on the best information available to him or her because patients can't always remember, or because the physician isn't aware of new research findings—prescribes medicines that interact badly with other medications already being taken. Some of the nation's best pharmacy utilization monitoring organizations report that they routinely find between 5 and 10 percent of all

patients' prescriptions need to be checked or altered because of drug interaction potential that the physician is often unaware of. This is just one of many different types of information-access related problems faced by our nation's healthcare providers as they struggle to improve the quality and efficiency of their work every day.

EFFORTS ALREADY UNDERWAY

The healthcare community and the information technology industry are already using advanced computing and communications to address these problems. Let me offer a few examples.

One of our founding board members, Ameritech Health Connections, is on a later panel today, and will describe their community-based healthcare information network in Milwaukee and the benefits that are already developing for patients there now. Bell Atlantic Healthcare Systems is implementing clinical data repositories and clinical decision support applications to support physicians, hospitals, community-based provider networks and managed care organizations, and employers committed to value-based healthcare services management and purchasing. Science Applications International Corporation is supporting, through its worldwide Composite Healthcare System Implementation project, the information management requirements of the military's healthcare system and its managed care initiatives. AT&T/NCR is working to provide community-based information transport networks, integration of diverse systems, and an outcomes evaluation system that benefits providers, employers, patients and their insurers; as well as to establish new ways to help physicians access critically needed information in rural settings and to obtain remote radiology consultations using telemedicine techniques. Hewlett Packard and Digital Equipment Corporation are working with hospitals and managed care organizations to implement new clinical decision support systems. And Andersen Consulting is working with 3 of the 14 communities mentioned earlier on new solutions for automating medical records and integrating the information systems of hospitals and physicians.

We are all also involved in standards setting bodies; are supporting demonstrations of new uses of information technology; and are working to create models for computerized patient medical records. Significant achievements are being made in the effective use of telecommunications and high performance applications and computers.

MORE NEEDS TO BE DONE

It is our view, however, that much more needs to be done, both to speed the development of new critical technologies and to broaden the deployment of integrated versions of information technology, if we are to achieve the kind of advances needed to improve access and lower costs.

It is our view that any effective healthcare reform plan must be based on a new national healthcare information infrastructure (NHII), which builds upon ongoing community and industry efforts.

This concept has been endorsed by the Computer Systems Policy Project (CSPP), an organization representing leading computer companies. CSPP has spoken out about the need for an enhanced information infrastructure that can support the use of information technology to weave the disparate pieces of the healthcare system together into an integrated and seamless system.

The benefits of creating a coherent healthcare information system are numerous. Arthur D. Little has estimated that better information systems could reduce the administrative cost of healthcare by approximately 20 percent or nearly $30 billion per year. An advanced information infrastructure will help to make clinical, administrative, and outcomes information more easily available at a lower cost. And consumers of healthcare services, and the medical professionals and managers providing those services will be able to make better decisions throughout the production and consumption of healthcare services.

PARTNERSHIPS BETWEEN GOVERNMENT AND INDUSTRY VITAL

While the benefits of creating the healthcare information infrastructure are numerous, it is a task which requires a partnership between government and industry. We are describing a complex paradigm shift in how information is used throughout the system—a shift to a new outcomes-based healthcare information system, organized around the patient, at the community level, and which will make information available to all information end-users whenever and wherever needed, both locally and nationwide, to support improved patient care; to reduce administrative costs; and to provide the data bases needed for medical research, healthcare policy devel-

opment and review, and day-to-day healthcare services purchasing decisions by consumers and their managed care program sponsors.

No single firm or group of firms have found themselves able to produce this shift alone. The challenge is to create new healthcare information network systems that: (1) are standards based, (2) provide repositories of administrative and clinical data for outcomes research and clinical decision support, (3) establish easy interoperability among systems used by hospitals, physicians, health insurers, government, and others, and (4) support ubiquitous access.

Though significant, it is not only cost which has prevented the evolution of these new systems, but the market uncertainty and the lack of agreed upon standards and reimbursement processes that present major barriers. Significant technology challenges also still remain as we proceed to implement this new healthcare system approach.

Further research and development are needed to continue and speed the adoption of high performance computing and communications capabilities. There are also numerous policy roadblocks which only government can address. Government clearly has a major role as both a purchaser, and as a regulator of healthcare delivery, to ensure both access and quality and protection of consumer interests. Government can also play a vital role as a catalyst for bringing parties together to apply the benefits of this new information solution.

A number of federal initiatives which can help accelerate the deployment of a new healthcare information infrastructure are being planned, or are already underway. Some of these include the High Performance Computing and Communications Initiative and the healthcare information technology programs of the National Library of Medicine (NLM), and other programs within the Agency for Health Care Policy and Research (AHCPR), the National Institute of Standards and Technology (NIST), and the National Telecommunications and Information Administration (NTIA).

NHIC PROGRAM AND ARPA

Another significant government program that is advancing the healthcare information infrastructure is the Advanced Research Project Agency's (ARPA) Technology Reinvestment Program (TRP). ARPA has designated healthcare technology—and particularly healthcare information systems—as one of eleven key dual use technologies for development in the TRP.

ARPA's program has served as a catalyst—further drawing together companies which were already involved in this new area of endeavor, and which were working to develop and deploy improved systems. Our consortium includes leaders in all sectors of the information infrastructure field—communications networks, computer systems, information integrators, and applications providers. Our Board membership includes Ameritech Health Connections, Andersen Consulting, AT&T/NCR, Bell Atlantic Healthcare Systems, Digital Equipment Corporation, Hewlett Packard, and Science Applications International Corporation. In addition, more than 20 other organizations collaborated in our response, and have indicated their intent to join the Consortium. Our vision is further shared by the 14 regional healthcare alliances which will serve as application testbeds to help deploy this new approach. Their involvement and our linkage to these regional alliances will help to ensure that advances in information technology will truly and broadly affect the delivery of healthcare in the U.S.

Working together at the national level we have developed a multi-million dollar, multi-year research, development, and dissemination project to address many of the key information management system problems in the healthcare field. We have submitted this proposal to the ARPA TRP for funding assistance under the TRP.

The four fundamental objectives of the NHIC ARPA proposal are:

- To validate the assertion that advanced information systems can improve and extend healthcare delivery at significantly reduced costs and to test whether technologies developed for the defense department are adaptable to healthcare information systems and community health management utilities;
- To develop a reference architecture and institute standards and tools to foster collaboration and exchange among individual information systems such that they serve as components within larger, more comprehensive healthcare information systems and/or networks;
- To develop a model and standards for a common medical vocabulary that is a key component of community and regional information networks and a national healthcare information infrastructure;
- To accelerate the adoption of more appropriate information tools, methods and architecture by healthcare organizations and individual practitioners.

One of the initial tasks in creating an integrated local and national information infrastructure for healthcare is to define a reference architecture, which sets out what the information "traffic flow" and capacity availability should be; which information systems should be able to communicate with each other; and most importantly, what interoperability standards are necessary to allow for these communications to occur. The idea is to create a framework to make sense of the "islands" of healthcare information currently in use, and to guide the establishment of new systems so as to create a coherent whole. The definition of this architecture is a complex technical task, but it is the principal basis for a national healthcare information infrastructure. It is one of the central objectives of our NHIC effort.

We believe achieving these four objectives is crucial to the development of a NHH. We recognize, however, that the success of our ultimate effort—to increase the availability and flow of information in order to improve the quality of healthcare and its cost effectiveness—will depend on the commitment and collaboration of a range of participants in both the public and private sectors. Our ARPA effort is meant to complement and enable the broad application of existing community and industry efforts, the work supported by the National Library of Medicine and others in the High Performance Computing and Communications Initiative, and the applications and testbed projects proposed in H.R. 1757 and Title XI of S. 4.

RECOMMENDATIONS

Based on our experiences to date, we make two requests of your subcommittee. We ask you to continue to promote legislation that will encourage and speed the development of a healthcare information infrastructure consistent with the broader National Information Infrastructure initiative. In addition, we strongly urge Congress to continue support the efforts of ARPA, The Department of Health and Human Services, NTIA, MST, state agencies and others to work together with industry to rapidly advance this effort through support of testbed and demonstration projects. The TRP process has substantially broadened the cooperative activities among the NHIC members and with our other collaborators. As your committee considers legislation in this area, we encourage you to look at the possibility of replicating elements of the ARPA model for working with industry in agencies in your jurisdiction.

SUMMARY

We are moving to a new paradigm in information management in healthcare, and this kind of change cannot be implemented overnight. We are confident that our efforts can produce quantifiable benefits in the near term, but instituting a national healthcare information infrastructure is a multi-year effort even with government and industry working effectively together. We are moving to an open, ubiquitous, interoperable environment where all users can share information; where practitioners can utilize communications to share images and communicate via multi-media; where patients' records and clinical outcomes data can be easily compiled, and used to guide both treatment and purchasing decisions; and where large data bases can be easily accessed to support a wide range of research needs—for both the public and private sectors.

Much work remains to be done. There are no silver bullets. But it is clear that the successful application of information technology, and the development of new business models to meet the information access needs of all users, can improve the treatment decisions made, and improve the outcome of the treatment itself. We believe that by applying today's and tomorrow's technologies to the delivery of healthcare services, we can help to alleviate the tremendous pressures on our healthcare system.

I would be happy to answer any questions.

National Healthcare Industry Consortium

Organizing Principals

- Ameritech Health Connections
- Andersen Consulting
- AT&T
- Bell Atlantic Heathcare Systems
- Digital Equipment Corporation
- Hewlett-Packard
- Science Applications International Corp.

Participants

- Ameritech Health Connections, Inc.
- Andersen Consulting
- AT&T
- Bell Atlantic Healthcare Systems
- Cimflex Teknowledge Corporation
- Digital Equipment Corporation
- Kodak Health Imaging
- General Electric
- George Mason University
- Harris Corporation
- Hewlett-Packard Company
- Hughes Aircraft Company
- Information Sciences Institute (ISI)
- Med Power
- National Computer Systems, Inc.
- National Electronic Information Corp. (NEIC)
- NCR Corporation
- New Jersey Institute of Technology (JNIT)
- ORA Corporation
- Perceptics Corporation
- Rosmann Health Industry Consulting
- Science Applications International Corporation (SAIC)
- Space Applications Corporation
- University of Texas
- West Virginia University

Regional Alliances

California	National Health Foundation
California	Northern California Healthcare Technology Alliance
Florida	Jacksonville Enterprise Center for Health Care Technology
Illinois	University of Illinois Medical Center
Massachusetts	Harvard University
Massachusetts	Massachusetts Institute of Technology
Massachusetts	University of Massachusetts
Michigan	Greater Detroit Area Health Council, Inc.
Minnesota	Minnesota Health Information Partnership
Nationwide	National Academic Medical Center Information Collaborative
Nebraska	Applied Information Management Institute
Ohio	Ohio Corporation for Health Information
Washington, DC	Washington D.C. Area Development Council
Wisconsin	Hospital Council of Greater Milwaukee Area

National Healthcare Industry Consortium

Objective

The members of the National Healthcare Industry Consortium (NHIC) will capitalize on a set of DoD sponsored tools and methodologies to develop a reference architecture framework and domain models that will be critical to developing a National Healthcare Information Infrastructure (NHII). NHIC will include leaders in healthcare information systems, network utilities, systems integration, hospitals and physician organizations, DSSA experts, government healthcare policy experts, and linkages for technology transfer and demonstrations with regional technology alliances.

Current Limitations

- Limited connectivity within and between healthcare-related enterprises
- Lack of an accepted industry architecture to enable a vigorous component-level marketplace
- Inability to provide architectural constructs and tools to enable integration of existing systems and migration to new systems

Core Technical Tasks

- Validating the assertion that advanced information systems can improve and extend healthcare delivery at significantly reduced costs
- Testing domain-specific software architecture (DSSA) concepts in the existing and emerging healthcare information environment
- Instituting standards and tools that foster cooperation and exchange among individual information systems resulting in a comprehensive healthcare information system
- Accelerating the adoption of the appropriate tools, methods and architecture to existing healthcare sites

Uniqueness

- Traditional competitors working together
- Full range of information infrastructure providers
- Tie to regional and community based healthcare alliances
- NHIC technical plan represents the first real road map for information integration in healthcare
- Establishes information infrastructure independence for the healthcare industry

Senator ROCKEFELLER. Thank you both very much. I guess we will have 5-minute rounds of questions, if staff could make sure of that.

One of the things that is always mentioned when people talk about communications is doctor-to-doctor, doctor-to-clinic, doctor-to-hospital, doctor-to-medical literature. There is an interesting fellow

by the name of Dr. Lawrence Weed, who is controversial, who has this theory which I like that a lot of the best decisionmaking is made when the patient and the doctor sit side-by-side, interacting as two human beings with a computer.

They ask questions, and they go through the medical history together and arrive at decisionmaking together, and at the end of the day, when they have asked a lot of questions, the patient takes the printout home and discusses it with his or her family. Often this process provides insights which the patient has shielded from himself or herself.

I am interested in that part. Everything does not have to be between the highly educated professional and the highly literate journal. I would like to know how the patient fits into this. This is for either of you.

Dr. LINDBERG. Well, I have known Larry Weed for about 25 years. He is not only insightful but brilliant and entertaining as well. He would make a wonderful witness here.

What you describe is, I think, highly desirable, and I think the current graduates of our best medical schools are being trained to think through treatment alternatives and tradeoffs with the patient. Not all patients, of course, want to do this, and not all patients have the educational background, but increasingly most do, so that is a very desirable situation.

When you translate it into thousands and thousands of persons, we have to confess that institutions like the National Library of Medicine basically have all they can do to keep up with serving the professionals, helping the patients through serving the professionals, so we are probably not as experienced at dealing with patients directly as the local hospitals are, where they do make a serious effort to deal with patients and patients' families. What you describe is very desirable.

Senator ROCKEFELLER. I think your answer is fair. Policy is crucial in all of this, in the High Performance Computing Act and S. 4, as I believe it will pass.

Let us say this S. 4 language—and this is to both of you—passes and you get the necessary funds. What will be your highest priorities, and what are the kinds of projects you and your colleagues might support?

Do you think there are any technical opportunities here that would provide spectacularly high benefits to the Nation? As I look at S. 4, there is one word here, "interoperable," that is huge in terms of policy, and, second, emphasis shall be placed initially on applications that can produce significant savings in national healthcare costs, so there is a discipline built in within the policy of this bill.

Ms. CADE. I would be happy to comment on that on behalf of the consortium. As a matter of fact, the three areas that we propose to address in our response to ARPA included focusing on the computerized patient medical record, trying to devise a standardized approach that we could use across all of the systems that we work in, gathering information in a uniform manner, and beginning to develop an outcomes management approach so that the information that is gathered can be assessed and provided back to purchasers, to employers, and even to patients and doctors themselves.

We also look at telemedicine as an area where we can dramatically begin to see an impact on the delivery on healthcare costs and an improvement in the quality by bringing people together to support their talking about the healthcare treatment with their caregiver without their having to travel perhaps 60 to 120 to 300 miles for a 20- or 30- or 40-minute interaction with a doctor.

Telemedicine can do a great deal not only in the initial extension of a doctor out into a rural area, but in involving that patient in the ongoing dialog with their doctor and followup. It can also do a lot to reduce the cost that you mentioned earlier of. Instead of shipping the patient to the doctor, we can now send the images and the information to the doctor.

Senator ROCKEFELLER. What is it that the Agency for Health Policy Research is doing in this area, and when you mentioned "we," Ms. Cade, are you referring to your professional colleagues?

Ms. CADE. I am referring to the consortium that I am representing.

Senator ROCKEFELLER. What is AHCPR doing in this, do you know?

Dr. LINDBERG. If I could respond, I agree that the long-range, most beneficial portions of all of the provisions of the bill is the computer-based patient record. That is really the open sesame to all the rest.

It is not a new idea. It has been in business for 25 years, and there have been serious attempts to do this, including Larry Weed and the Promise system back in the early sixties, and many, many other good places. The reason we do not have it is we have never had a national commitment to require it, nor probably adequate funding to get the developments through. I think this is the moment at which it might be possible to do this.

The broad agency announcement I spoke about from NLM is, in fact, cosponsored by ARPA and by the Agency for Health Care Policy and Research and the National Cancer Institute. You asked about AHCPR, if I could use that abbreviation. They have a statutory requirement to produce clinical practice guidelines.

We, by the same act, have the responsibility to disseminate those guidelines through computer and other methods, so that will be very, very central to achieving health reform and economies. We see that working hand-in-glove, and of course, the better it is integrated to a computer-based patient record the better off we will all be. We see that that agency has that prime responsibility, too, although we have some talent, ARPA has some talent, and we hope a lot of money to put to it.

Senator ROCKEFELLER. Two quick questions:

First, you have not mentioned the Veterans Administration. It is the largest healthcare system in the world at the present time. I have an interest in the linkage of that patient base. Veterans, after all, do not always stay in hospitals. They move back into society, back and forth, so that is one. What about the VA?

Second is the extraordinarily intricate, delicate question of privacy and protection of rights therein. We are dumbfounded in the glory of data bases, and Senator Pressler's, Senator Burns', and Senator Rockefeller's computer systems are shut down several times a week by accidents and things that go on around here. Reli-

ability and privacy are important issues. I am concerned about one issue in particular, and that is the invasion of privacy in computerized information.

Dr. LINDBERG. I think we both should answer this. I will answer very briefly, Senator. The test bed networks that are prescribed in the bill I think are absolutely essential to work out the practical matters of this privacy issue. We know how to encipher things till the cows come home. We do not know exactly how to do that in a medical center. We need a practical experiment to determine that.

With respect to the VA, I have been amazed that they have not chosen to be part of HPCC, either. They would certainly be welcome, at least to step in as guest members at any time.

Senator ROCKEFELLER. They have been invited but have declined.

Dr. LINDBERG. They have not accepted yet. The VA has, however, submitted an application to this NLM broad agency announcement, so they apparently are willing to join up to that.

Senator ROCKEFELLER. My time is up. Senator Pressler, I did not even give you a chance.

OPENING STATEMENT OF SENATOR PRESSLER

Senator PRESSLER. Senator Burns was here first.

Senator ROCKEFELLER. But I want to apologize for not giving you a chance to be heard.

Senator PRESSLER. Well, I am sitting to your right today. That proves that I am to the right of you. Actually, it is so that I can see the screens. I did not want to be on Conrad's lap. [Laughter.]

I do have an opening statement saluting both of you for holding this hearing. I will not take the time to read it, but I thank our witnesses. I am very eager to see this demonstration.

[The prepared statement of Senator Pressler follows:]

PREPARED STATEMENT OF SENATOR PRESSLER

Mr. Chairman, I commend you for holding today's hearing on advanced computing in healthcare, otherwise known as telemedicine. I also would like to commend my distinguished colleague from Montana, Senator Burns, for his leadership role in proposing this hearing. It will serve both a practical and educational purpose. Telemedicine could help solve two of the most critical issues facing our nation—skyrocketing medical costs and protecting the uninsured. We are all familiar with the national statistics. We all agree something must be done to contain costs and secure medical benefits for more Americans.

In my state of South Dakota, 56,000 individuals are without health insurance. 5,000 individuals are considered uninsurable. A recent study of healthcare costs reveals that the average South Dakota family spends 13.1 percent of its income on health insurance or health related costs. This is the fourth highest rate in the nation. Between 1980 and 1992 health costs increased by 106 percent, compared to the general inflation rate of 68 percent. Nearly 20 percent of my state's population are senior citizens. This is higher than the national figure of about 13 percent. Consequently, South Dakota medical providers are more dependent upon Medicare than providers in other areas of the country. I cite these figures to illustrate the magnitude of the healthcare crisis in South Dakota.

There is one aspect of the healthcare crisis that is rarely discussed: access. Both the insured and uninsured in rural areas experience this problem. Many are forced to drive hundreds of miles to get medical attention. 54 of the 64 counties in South Dakota are considered "medically underserved." We have 63 hospitals including the Veterans Administration (VA) and Indian Health Service (IHS) facilities. 23 communities are attempting to get a medical doctor to locate in their town. Dozens of other small towns have given up and are no longer seeking a physician. It is not uncommon for a small town to attempt to recruit a physician for several years. Since 1980, four hospitals in South Dakota have dosed their doors.

South Dakotans already have taken an innovative approach to solving this problem. 154 Physician Assistants have located in my State. Most of them work in small towns that do not have a physician. These PA's are working directly with doctors in larger communities to deliver needed medical services. Telemedicine can play a vital role in this process.

I am working with the city of Aberdeen and surrounding communities in northeastern South Dakota to upgrade their telecommunications network from analog to digital switching. Recently, at a public meeting in Aberdeen, area doctors and medical professionals discussed the services digital technology would allow them to provide. Doctors at the Aberdeen hospital could watch and consult in operations at clinics in the surrounding counties while they occur. Many area hospitals do not provide obstetric services because of liability problems. Patients in Milbank, Mobridge, and Huron could use video conferencing to consult with their obstetrician in Aberdeen. Ipswich has closed its hospital. To meet patient demands there, a doctor in Aberdeen could perform examinations with video conferencing and the help of the physician's assistant or nurse practitioner in Ipswich. With high-speed data links, diagnostic data could be shared immediately, not only among hospitals in the area, but also with specialists at the Mayo Clinic or University of Minnesota Hospitals. I understand we will be seeing a demonstration today of how the Mayo Clinic uses telemedicine to diagnose patients at a remote location.

South Dakota's state-of-the-art fiber optics network—the Rural Development Telecommunications (RDT) Network—currently connects St. Mary's Hospital in Pierre to other RDT sites throughout the state. By the end of this month, Sioux Valley Hospital in Sioux Falls and Rapid City Regional Hospital will be added to the network. Initially, the hospitals will use RDT for administration and training—activities easy to schedule along with those of existing RDT educational used. RDT is looking at extending the network from hospitals to primary care providers and specialists in other locations. Medical emergencies need instant access to the network. People don't schedule heart attacks. RDT is considering allowing part of the network to be preempted at any time for medical uses.

South Dakota communities and medical professionals are progressive in their outlook and want to adopt procedures that will advance medicine in their respective communities. Telemedicine is a cost saver for doctors, hospitals, and most important—patients who won't have to travel hundreds of miles for quality medicine care. Telemedicine needs to be part of healthcare reform. I hope today's hearing will further demonstrate that need.

Senator PRESSLER. I just have one question. When I was in the Army, for part of the time over in Vietnam they had the Advanced Research Project Agency trying to figure out how to win the hearts and minds of the Vietnamese people, so I have always followed ARPA. They changed it to DARPA for a while, but now it is back to ARPA.

In your testimony, Ms. Cade, you say on page 8 that "Another significant Government program that is advancing the healthcare information infrastructure is the Advanced Research Project Agency's technology reinvestment program. ARPA has designated healthcare technology, and particularly a healthcare information system, as one of the 11 key dual-use technologies for development in the TRP."

I am very interested in dual use, and so forth. What does that mean?

Ms. CADE. In our consortium, our response to ARPA was based on our willingness or our ability to take some technology which had been developed with funding from DOD and try to find an application for it in a commercial environment. And, in fact, the technology that we will be using is a software architecture approach which really allows us to reach back and protect the investment in software and hardware that is already in place in the hospital while we build an architecture, build new systems, and bring in some new capabilities.

So, we are taking a piece of Government-funded software and finding a new commercial application for it, building new applications in software, and reaching into the future with that capability. It is a conversion, if you will, of an investment that the Government has already made.

We are also using a lot of tools and resources that are obviously commercially invited and developed, in some case, by our own companies.

Senator PRESSLER. Thank you.

Senator ROCKEFELLER. Senator Burns.

Senator BURNS. Thank you, Mr. Chairman. I just have a couple of questions that I want to clarify on setting aside funding for everything we want to do, especially with you, Dr. Lindberg, and how it is dealt with in S. 4.

I would ask you, other than what we have set aside in S. 4, to accelerate or to take the technology that we have right now and get it into the marketplace and get it into practical uses, what do we have to do as policy makers to enable or to accelerate what we already know and get it into practical applications?

Dr. LINDBERG. I think keep a steady hand on the helm. I think you have set the right course. Do not abandon this course in the midstream. The HPCC as a program is on target. In fact, it is ahead of schedule. It is on budget. It is getting additional agencies to participate very appropriately, I think. NIH is a relatively small participant. EPA is a tiny participant. Education is even smaller than that. We have a long way to go.

NOAA and NIST are very, very tiny parts of the basic HPCC program. They would be participants in this NII in the provisions that S. 4 calls for. So, you are not going to have applications and dissemination and understanding of that program until we move on to what you have prescribed in S. 4. I think it is a very, very wise course.

Senator BURNS. Going on with that, the participation as far as NIH and Education and those two areas and, by the way, this application, these technologies as far as telemedicine, that is what we are going to talk about. And I want to get on to the demonstrations. I am moving right along here.

This also has application as far as your inner cities go. We have the same problem in the inner city of availability and access as we do in our rural areas, especially our inner cities where we have a declining tax base. We have people who want medical care and yet the clinic may only be 2 blocks away and has practical application.

So, I will be in contact with you with some written questions, and I want to get on with the demonstrations because I think that is what we have come to see today. I want you to turn this over in your head that there has to be other things that we do as policymakers to accelerate and to get this out here.

Maybe it is time to bring NIH and EPA and Education and NOAA—maybe if everybody comes to the table and says, "OK, we have got some technologies and we are going to need your help and your cooperation in order to accelerate this." Would that be a practical suggestion?

Dr. LINDBERG. I think I am speaking for the White House Science Office when I say that they believe that the applications

specified in S. 4 are very good applications, but not all that could be in the future brought to bear. And you have just described some of those. Environment is another area where the HPCC agencies would like to see interagency programs submitted. So, we agree, it has a long way to go.

Senator BURNS. Ms. Cade, thank you for your testimony. I will have some written questions for you. Mr. Chairman, I thank you.

Senator ROCKEFELLER. Senator Stevens.

Senator STEVENS. I am sorry, I had to attend the other committee's meeting. I wish I could have been here during part of this because I have a great fear that once again my State is going to be left in the 20th century when you all go into the 21st, and that is why I am here. I want to be very careful about being able to understand what is happening.

We are still dealing with community health aides that have high school education if possible. Many of them do not even have that. And we have over 140 villages that have such people delivering healthcare. If these systems can help them, that is fine. But if they become so complicated that they push them back further, into the 19th when everyone else is going into the 21st century, then I think that is not progress. So, they have to be universal in application. That is what I hope we will all keep in mind.

Senator ROCKEFELLER. That is exactly what I wanted to get at. And I know we want to get into the demonstrations, but this policy aspect is incredibly important. So, I ask one question which is really the same as Ted Stevens'.

You take South Dakota, West Virginia, Montana, Alaska, and it is classic, it is absolutely classic for Americans when we see some marvelous piece of technology, interactive, you know, and we just dazzle. And we want some wonderfully simple, marvelous new invention which is in the hands of others who we trust because of their technical skills, and then we all of a sudden discover it is much more complicated, and that in fact in rural parts of our States, and in particularly my State and southern parts of that, doctors tend to be much older and, therefore, much less accustomed to using computers if they have ever used one in their life.

And second, my mind then immediately wanders back to the invasion of Grenada where the four branches of the military, and Ted Stevens can correct me if I am wrong here, had to basically dial by phone Washington in order to communicate with each other on the island because they all had different forms of communication which were not interactive.

So, my question is very simple. Face those dilemmas for me in the real world of medicine and technology and help me relax.

Senator STEVENS. I will tell you you are right, but it was four generations of the same technology. Do not forget, they were using four generations of the same technology.

Senator ROCKEFELLER. Well, I was just thinking that in parts of rural Alaska and West Virginia the technology would be different brands, different eras, different decades. I mean, it would just be complicated.

Ms. CADE. Let me address that question first by saying that we have to have a commitment. When we talk about a national commitment to moving ahead, we also have to have a national commit-

ment about interoperability. In very simple terms, that means whether I am talking on a cellular phone or the phone from my home, the call goes through because there is interoperability in our systems. We need that kind of expectation, and as vendors and as policymakers we all need to require and expect interoperability across different kinds of technologies.

Our consortium is focused on that need for interoperability and standards. That is why we are doing this. We are manufacturing and creating applications today and selling that technology in the marketplace. That is who we are. But as we move ahead with new applications, we feel that we must have a standards based environment that is committed to that kind of interoperability.

On your first point, I would say that when you look at funding demonstration projects, you should make sure that what you look at does include the people who are going to be using it ensuring that end users, real people who are going to use this technology, are involved in any demonstration project, so that we are not just creating sophisticated computer screens that change how people deliver healthcare, but we are creating applications that are human oriented. So that if I normally as a doctor examine a patient and write on a chart, that is what I still do, but it is an electronic chart. If I normally examine a patient and dictate some comments to a record, that is what I still do, but it is captured electronically.

All of that is included in our in our proposed demonstration project. And I would say that that is the kind of expectation that you should have of us, that we include putting this technology in the hands of the users as a part of our demonstration project.

Senator ROCKEFELLER. Are there any other questions?

Senator STEVENS. No, but a last comment. I am still not sure that I am getting through, particularly to Ms. Cade. I will give you just one example. We are dealing with water and sewer problems in rural Alaska, and I came up with the bright idea of why do we not use some of these toilets we have on boats now, all right, that just incinerates human waste, and they are very effective, and do not have to have pipes and everything else because the water and sewer systems were costing so much. So, we costed out what it would cost to run one of those things for a month in one village in Alaska where they pay $3.70 a gallon for fuel. It is $240 a month to run one john.

Now, you tell me what it is going to cost to run your systems in that community for a health aide that currently gets paid $400 a month?

Ms. CADE. Senator Stevens, I do not mean to be nonresponsive to your question, because that is a very serious concern of how do we make these systems affordable; and how do we extend them, and how do we make them modular so we can break them apart and have a small version and a large version.

We are trying to work on those problems. And I am not going to tell you that we feel that we have the answers, but they are problems which as individual providers of technology we are all trying to work on. And we are committed in our consortium and in our response to ARPA to try to advance the state of technology so that we can reach a point quickly where we are able to make those ap-

plications affordable in the environments that you are talking about.

Senator STEVENS. Thank you.

Dr. LINDBERG. Can I make an addition? I would like to contrast just very briefly the cost of connecting to Internet in Rockville, MD and Anchorage, AK, because it happens that we have looked into that matter.

One of the library's advisors, a businessman in Rockville, told me recently that he had shifted the direction of his business and he was really very enthusiastic about doing it through data bases and high-speed lines and so forth. So, he called up the local phone company and said he wanted a T–1 line put in. That is a million bits per second, a good line. And they said, "Oh, well that would take a while to do." They did not think they could get it in until next Wednesday. So, he said that would be fine.

And then he called and told me about his decision. And I asked what did it cost. And he said, "Oh, well gee, I forgot about that. A couple hundred dollars a month, something like that." That same day we got a call from our regional medical library in Seattle which had tried to establish a T–1 line to Anchorage and they were quoted $30,000 a month.

You can do the same thing, but the distances are such and the population densities are such that the costs are staggering. We are very well aware of that. And I think the national commitment ought to be for, if you will, something like an 800 service that spreads the availability across the whole United States or invokes satellites or some other system. You cannot disenfranchise Alaska or other rural areas.

Senator STEVENS. You probably came in on the new 800 system and they were looking for customers during that period. They have just come into Alaska this year. The rest of the country had them 10 years ago.

Senator BURNS. If I could interject here, I think with usage that cost really plummets, especially electronics and the usage of electronics. We must never forget about that. Initially it is pretty high, but as users come on board the cost drops dramatically.

And I thank you, Mr. Chairman, and I want to go on.

Senator STEVENS. I want to go on, too, and I am sorry I held things up.

Senator ROCKEFELLER. Well, we are going on. I, incidentally, happen to think that it will be rural areas that will gain the most from all of this, that will make the most dramatic advances.

You have been superb witnesses, both of you. I am very grateful to you both. Thank you.

And now, our demonstration panel. Ms. Marsha Radaj who is vice president of operations, Wisconsin Health Information Network. Eric Tangalos—let me say that there is no statutory requirement that when one panel stops everybody has to start talking.

Second is Dr. Eric Tangalos, assistant professor of medicine at the Mayo Medical School in Rochester, MN. And Dr. Julian Rosenman who is also a physician, associate professor, Department of Radiation Oncology, School of Medicine, University of North Carolina, Chapel Hill.

Gentlemen and lady we welcome you and we turn this over to you. Have you decided who goes first? If so, go ahead.

STATEMENT OF MARSHA RADAJ, VICE PRESIDENT OF OPERATIONS, WISCONSIN HEALTH INFORMATION NETWORK; ACCOMPANIED BY JOE SULLIVAN, PRESIDENT, AMERITECH HEALTH CONNECTIONS, AND ALLEN PERES, MANAGER OF BENEFITS PLANNING, AMERITECH HEALTH CONNECTIONS

Ms. RADAJ. We are going to do a live demo and we are trying to get a phone connection.

Senator ROCKEFELLER. Bring the microphone right up and keep it at about 1 inch. And if you are turning back and forth to the screens, take the microphone with you. You have got to keep it about an inch from your mouth.

Ms. RADAJ. OK. This is going to take just a few seconds for us to set up because it is our intent this morning to do a live demonstration for you so that you can see the network in use as it is today in the State of Wisconsin.

Senator ROCKEFELLER. Good. And even as you say that, I mean an inch.

Ms. RADAJ. An inch.

Senator ROCKEFELLER. Nobody in the back can hear a word you are saying. So, you really have to speak clearly and have the microphone stay with you.

Ms. RADAJ. Senator, I would like to say thank you, as chairman of this committee, for the opportunity to be here today, to speak with you, and to share with you the Wisconsin Health Information Network. Additionally, I would like to extend a special thanks to both you and Senator Burns for your support of the healthcare initiative, for allowing us to be here, and our participation at this committee hearing.

My name is Marsha Radaj. I am vice president of operations for the Wisconsin Health Information Network. Seated with me is Joe Sullivan. He is president of Ameritech Health Connections. With us in the audience is Allen Peres who is Ameritech's manager of benefits planning.

WHIN is the result of a joint venture between Aurora Health Care, which is one of the leading providers in the State of Wisconsin, and Ameritech. This product became commercially available in March of this year.

We are the first implementation of Ameritech's rollout of the regional health network strategy, and we are very excited about the fact that we are also this country's first implementation of a fully functional health information service that is providing health information across standard phone lines, utilizing existing technology, and state-of-the-art software.

We are excited about our status. Although WHIN became in March of this year we have on board 7 hospitals, and over 250 physicians, representing 1,850 beds within the State of Wisconsin. That effort has just been accomplished in as little as 4 months.

WHIN believes, and I hope you will all agree at the end of this presentation this morning, that there is a way for us to lower that administrative cost of healthcare. It is our goal, and we believe solemnly, that we will be able to exceed a reduction of a minimum of

20 percent. I think that you will see that as this demonstration plays forth.

While we are very excited about what is going on in the State of Wisconsin and what we are doing, we know that we are just beginning. We are already preparing for the rollout of our second release of this software.

I have to tell you, though, that we also face the restrictions that have been imposed on the regional Bell companies. Our goal is to deploy WHIN throughout the State of Wisconsin and to allow this product to be used not only in a metropolitan environment in a cost-effective fashion, but to deploy it through the State for the rural physician, and to not only allow him or her access to the system, but to allow that access at a lower cost.

With that, what I would like to do is demonstrate the WHIN product for you. And I was very pleased to hear some of the initial comments because I think some of the things that were referred to today you are going to be able to see in this demonstration.

Although I was talking while the sign-on was going on, one of the key things we found as we were implementing this product within our environment is the fact that there is no utilization if you cannot connect very easily and very quickly. And within as little as 10 to 15 seconds, the user of the WHIN system is able to log into the network.

Time does not allow me to do a full demonstration for you this morning, however I will be available after this hearing if anybody would like to have a private demonstration.

As you look at the screen, I would also like to share with you that along with lowering the cost of healthcare what we attempted to do is bring a product to the market that met the needs of the market as it is today. It was not our goal to go into a physician's office and cause him or her to purchase additional hardware.

This system was designed to run on the lowest common denominator, a 286 class machine which we found through the State of Wisconsin, and although if you look at the system you will see it has a very modern look and feel. The Windows version is already in alpha site and soon to be deployed. You will find that this will be functional in most physicians' offices and within hospital departments.

As I enter the system, I am just going to be entering a log-on ID and a password. Entering that log-on ID and password, it really belies the security that is underneath.

All of the data that flows across the phone line is encrypted. If there is a hacker out there that is attempting to log into the line, the data is scrambled. We are accessing a live data base today, however it is a test data base within one of our provider organizations. All of the data within that data base is also encrypted.

I am very excited to tell you that during the life of a transaction the hospital is really the owner of the data. As WHIN, I do not own a data base. The hospital is the entity that authorizes access to the system. That authorization appears on the screen in the form of a list of users. We worked with the State medical society and also with one of the leading law firms in the State of Wisconsin in the design of the disclaimer that you see on this screen.

Now, if a hospital indicates that there is a transaction that has very sensitive information in it, what we can do is during the life of the transaction actually disable one of the user's printers so that they cannot print anything they see on the screen. We can also disable their disk drive so that they cannot save any of this information and manipulate it in any way.

When anyone logs onto the system the very first thing that happens is we run a virus check. We cannot afford to have a virus running through this network, and so WHIN takes the responsibility of verifying that this is not only an authorized user of the system, but that they are accessing the system with hardware that is clean.

We also know if there are memory changes or if a new program has been loaded on that system. So, we are very cognizant of security. I think you will see some of the additional features as we go through the system.

When we are allowing access, it is very difficult for you to see, but in the upper right-hand corner there is notation that says two mail messages and 32 deferred responses. As a user of the system, I have access to fully functional electronic mail, and I am, in effect, hooked up to every single user and hospital that is on the network today.

The 32 deferred responses—and, by the way, that number is going to increment as we go through the demonstration as information is being communicated to me, I am on line to that electronic mail facility, so that I know if someone has sent me something, if a hospital has sent me something or another physician.

Senator ROCKEFELLER. Is there any way for you to make that a bit brighter for visibility reasons?

Ms. RADAJ. I think we are limited to the brightness because of the transmission through the data show unit that is allowing us to translate the image here. We might be able to make it a little bit clearer or to push it closer. We can try.

I can see that it is difficult to see and, as I said, I will be happy to do some individual presentations at the end of the committee hearing. I do not know if that helps at all.

Senator ROCKEFELLER. It does, in fact.

Ms. RADAJ. A little bit.

Senator STEVENS. Can you turn off the monitors over there, Mr. Chairman?

Ms. RADAJ. Regarding the 32 deferred responses—WHIN allows the communication of information in a variety of ways. The first way is, if, as a physician, I would like all lab results automatically sent to me, I can sign onto the network and have them automatically sent. I do not do anything to initiate that transaction to occur.

A second way that I can access information, is when I am on line with a hospital system. When we were talking a little bit ago about this thing called a longitudinal patient record or a computerized patient record, one of the neat things about WHIN is when I log onto this system not only can I select the hospital that I want to access information at, but I can also select the prompt that said, "All." If I want to send out a request for information about Marsha Radaj to all of the hospitals that are out there, I can do that through this system. And any hospital that is on the network at that time will communicate that information back to me.

The A.D. Little study, a copy of which is included along with my testimony, has documented that 30 percent of the information that a physician needs when a diagnosis is made is not available to that physician at that point in time. As a patient, and I think for all of us in the room as potential patients——

Senator ROCKEFELLER. Could you repeat that? You said 30 percent of necessary information is what?

Ms. RADAJ. Information is not available for a physician when a diagnosis is made.

Senator ROCKEFELLER. Is that because of his or her insufficiencies, or because of what?

Ms. RADAJ. It is because, No. 1, physicians frequently have multiple sites from which they practice, information is stored in bits and pieces at differing hospitals. The average physician practices at three hospitals, and the average person tends to move every 5 to 7 years. And as we move, pieces of our information are scattered throughout not only a geographic area, but—and this is even a little more scary—they are scattered throughout the hospital.

As we are moving away from inpatient stays to more outpatient stays, what is happening is this information is no longer being stored within the medical records department. It is being stored—a little bit of it is at the surgery center. We have recently found out that a lot of it is stored up in the business office. There is not one place where all of the information is available.

Through this network, and because we allow access to multiple systems within a hospital—and, by the way, we do not cause a hospital to incur an additional investment in hardware when WHIN becomes part of that hospital's offering, we interface with the systems that they already have available—and we can spread that information throughout the network.

I am now at the main menu. I know it is difficult, particularly for anybody in the back of the room to see, but across the main menu are all of the options that are available to us as users of the system. We are very aware of Windows and new technology, and you will see that as I move the cursor across the main menu, it has the look and feel of a Windows environment. There is a brief descriptor underneath the menu bar, and on the very black bar along the bottom of the screen is a sentence-like descriptor.

When this system was designed, we lobbied long and hard to have on-line help available, because we are very aware that someone using the system does not want to have to go to a manual and try to find out how to do what they want to do. One individual, who was part of the development team, almost died the first time he heard me give a presentation, because my goal is, and I would be very disappointed if, at the end of this presentation anyone in the audience would not be able to come up here and actually use this system—it is that easy.

One of the neat things about it is when I log on, I have authorization rights at six different hospitals. No matter what I do through this system, the look and feel is exactly the same. We have received requests from physicians at one of the hospitals that is currently participating in the network, and he is lobbying to have WHIN terminals placed throughout the hospital, so he, when he is working within the hospital, does not have to go to one device to

access a census, and go to another device to try to find lab results, and an F1 means this here, and an F1 means that there.

Here we have a common look and feel not only at one hospital, but across all the medical information facilities that are a part of this network.

The main menu allows access to the system in a variety of ways. We are going to just go through one of them this morning. But I would like to share with you that I can do a patient search by name, and that is determined by the hospital. It can be an alphabetic name, which would be Marsha Radaj; it could be a name string, which could consist of as little as one alphabetical character, such as an R; it could also be soundexed. Radaj is a hard name and somebody could say, well, it sounds like R-o-d-i, and type that into the system. So we have three ways of accessing patient information.

The one we are going to concentrate on today is my very favorite, and is a result of my having worked in physicians' offices since 1984. As the years have gone by, every time I am in these offices they say, "Come on, Marsha, we know the hospital has this and we know the hospital has that." Isn't there a way that you can get that in the network? How can I get access to that information?"

And every time a physician or someone in a hospital department or a member of a physician's staff asked me or some of my staff some of those questions, we had this big manila folder into which we put all those requests, and we were real excited and are currently very excited, to be able to go back to all these offices and say, "We heard the message. Is this what you meant?" And, "What else can we do for you?"

I also have to tell you that as this system was being developed, we actually worked in doctors' offices. We sat and we watched not only the way the clinicians and the physicians work, we watched the way staff worked. Why are you calling a hospital? How long does it take? Why are you calling a payor? What kind of information do they need that you have to provide that was not available when you first sent the claim? What are you doing with the utilization review form?

It was really interesting for us to see how they process information. And this is one of the results. I know this is not going to mean very much to any of you as you take a look at this; however, I hope that I can effectively communicate how significant this is for an office. Because what we are going to do is display a patient list, which is a census.

But I have to tell you, this is a census like none you have ever seen in a hospital before. Because, by definition, a census is a listing of all of the inpatients in a hospital—and this does not show it—but you would also see that this list also shows you discharged patients. Because we wanted to provide a system that was fully functional, that met the needs of a broad audience. And that audience is not only the clinician and the physician, but it is also users in hospital departments, and it is also in offices.

We have also provided a "More" screen. This one screen, in an average office, saves one-and-one-half hours a day in time, and it is simply called the "More" screen, which is F5. And, again, it is going to look like a little thing to you; however, if you watch as I

am moving the cursor down the list, you will see that the information at the top of the screen changes. And what that information is, is all the billing information that is required.

The offices have also asked us, although we have only been in the marketplace since March of this year, to expand the "more" screen and include additional information.

I mentioned a little bit earlier that I can access information at all hospitals that are part of the network. I can also highlight every one of the names on this list and move into the system and say give me everything about everybody. And with two keystrokes, that request can be accomplished.

However, what we are going to do at this point is select just one of the patients, and move forward into the system.

You will see that we have moved to a screen that has only three menu options on it: one is hospital transactions, one is physicians associated with this case and one is next patient, which simply takes me back from whence I came.

What I would like to share with you, though, is the hospital transaction screen. Here a physician or a user of the system can sit down and, at one screen, access absolutely everything that is available.

Now, this screen that displays is dependent on the hospital or the facility that I am logged on to. For example, if a hospital provides the ability to do a scheduling inquiry, that would be a menu option on the screen.

I would like you to notice that we can access demographic information, including insurance information and guarantor information, lab results, which I am going to go into, and lab results differentiated by today, last 48 hours, and all the results. What I would like to show you, though, as we move through it—and we are going to move through it very quickly—while this request is being sent to the system, you will see toward the bottom of the screen, within the transcription area, it says "All transcription," it says, "All medical records," and at the very bottom it also says, "All transactions."

I can send out a request at this time, again, saying send me everything. And I will continue working on line to the hospital that I am attached to.

You will notice that at the very bottom of the screen a message has now appeared that says, "Forty lines of lab results have been received." This is a typical lab results display, but we take it a step further because, for the physician, what we do is if one of these results is abnormal, what we do is put an asterisk by it and, over on the right-hand side of the screen you will see the normal range.

Now, the few things that I would like to show you on this screen are the ability to mark information. This saves a significant amount of time within the offices, because it allows me to mark discrete pieces of information. And at this point I can do a number of things. I can print. I can save. I can send. We are working actively with three of the practice management vendors within the State of Wisconsin and, with one keystroke, users of this system can download data from a hospital system right into their practice management system without having to rekey it.

We recently had a user group meeting for the office managers that are utilizing this system. We had managers stand up in the audience and say that they have recently had staff leave their office that have not had to be replaced as a result of this system being in place.

The one thing I would like to take just a second to show you here, because it is one of the most exciting things on this screen, in my opinion, is the ability to send. When I press send, I have the option of sending everything, the current screen or just what I have marked. But look over at the right. I can send it via E-mail. I can send it via fax. And if I were to say at this point, to move forward through the system and to send, I fall into the send option. This looks just like the electronic mail facility.

At this point, I enter the subject to whom it is being sent. I can send with one keystroke to one office, or I can send to 10 offices. And if I don't remember the numbers, that is OK, because there is a data base that is sitting behind this that has the office numbers, and that is my on-line help.

And notice how—and those that are sitting at the table with me can see—I really did just press one key and I bounced right back into being on line to this hospital.

The last thing that I would like to show you today as we go through the system is I would like to take a second to show you this option called "All," because this is one of the things that differentiates us from any other products that are out there. The ability to be on line to a system to receive results without requesting them and to go into deferred mode.

You will see on the bottom of the screen, it is telling me exactly what is deferred.

Do you know the way offices use this? What happens is at the end of the day, they can say send me everything about everybody the physician is going to see tomorrow, and in the morning when they get there, all that data is available.

As we close out this presentation, what you will see is in the upper right-hand corner, where it says 32 deferred responses, that number is going to be incremented as we are continuing with the demonstration, because I am on line to the electronic mail facility. This also provides an opportunity for an office to save money, because if I get interrupted at what I am doing, I can just press the defer key and go and do whatever I have to do.

I have been in offices where the receptionist is the scheduler, is the nurse—the physician comes in and says, "Can you go in room two and give an injection?" And I am sitting here trying to retrieve some information. All I have to do is press the defer key, go in and give the injection, come back, and I do not have to place a second phone call, because I am still on line to the hospital to which I initially connected.

Senator STEVENS. Who puts information into this system? How many people do that?

Ms. RADAJ. We are really accessing data that is not stored at WHIN. WHIN does not store or is not the holder of a data base. WHIN is the electronic highway that passed the information. What we are doing right now is accessing information that resides at a particular hospital or at multiple hospitals. And when I issue a re-

quest, what happens is, in the background, this request goes out through the WHIN network to the different systems at a hospital. And the reason it goes so quickly is because one request does not go out followed by another one. Multiple requests go out at one time and then WHIN draws them all back together and presents them to me as the user of this system. And that is why we are getting such outstanding response time.

I do want to reiterate. We are using existing technology today, going over standard phone lines. And the way this system has been designed, although we can run on as little as a 286 platform, we are able to provide this type of response for a physician. And what we have really found is that access to the system is really a detriment if it is not fast.

We have found that for a physician, 20 seconds is too long. And you will see that in most cases we can provide under 10-second response time when logging into the system.

If you have noticed, just while I have been talking, in the upper right-hand corner, it now says 37 deferred responses. We will go in a minute into the deferred response mode and I will be able to show that to you. The first thing that I would like to show before we transfer there, though, and this has been a great time-saver for the offices, and that is the physicians associated with this case.

It is very difficult to comprehend what an office person goes through. If you are in a specialist's office, frequently, the doctor will come in and say, "I saw Marsha Rad-something a week ago at hospital A," and an office person will sit there and say, "Marsha Rad-something. When is she coming and what am I supposed to do?" Without knowing the other doctors on the case, it is almost impossible. An inordinate amount of time is spent by office staff trying to retrieve that information.

So, what did we do? We provided them the ability to access all of the physicians on that case.

Senator ROCKEFELLER. Marsha, we have five more witnesses, so you have 2 more minutes, and that is all.

Ms. RADAJ. OK. I am available at the end of this presentation; I would be happy to show the rest of the demonstration. I am excited about this system.

The last thing I would like to leave you with is to say, again, I thank you for inviting me to be here and to demonstrate the WHIN product for you.

In addition to all the clinical information we provide, we are also an all-payor solution for our offices. So, that is an additional way we are assisting users in meeting their cost objectives.

Thank you.

Senator STEVENS. What does it cost me if I join WHIN?

Ms. RADAJ. If you are a physician, it costs as little as $45 a month, which, in most cases, is under the cost of your cellular phone. WHIN is a cost-sharing model. And what happens is all of the participants pay a little bit. No one takes ownership for the entire cost.

Senator STEVENS. Are there any public contributions, or is it all private?

Ms. RADAJ. It is all private.

Senator STEVENS. Thank you.

Senator ROCKEFELLER. I did not mean to cut you off, because your enthusiasm is incredible. Actually, I was checking in on the Senator recorder just to find out if she was still able to breath. [Laughter.]

Marsha, you were terrific. You put a lot of pressure on Dr. Eric Tangalos, who is our next witness.

Ms. RADAJ. Thank you, Senator.

Senator ROCKEFELLER. Dr. Tangalos, please proceed.

STATEMENT OF ERIC G. TANGALOS, M.D., ASSISTANT PROFESSOR OF MEDICINE, MAYO MEDICAL SCHOOL; ACCOMPANIED BY SHERYL HILL, HEALTH CARD ACCOUNT MANAGER, US WEST

Dr. TANGALOS. Mr. Chairman, my name is Eric Tangalos. I am a practicing internist, primary care physician at Mayo Clinic. My practice is limited to patients who live in Rochester and who live in the nursing homes in Rochester.

My partner today is Sheryl Hill, an accounts manager for health with US West.

At Mayo Clinic, we have had a long period of time, since 1986–87, when we opened group practice sites in Jacksonville, FL, and Scottsdale, AZ, to link those sites together with advanced communication modalities. We practice telemedicine in the consultative fashion, using satellite broadcast-quality analog video since that time.

Given our background with those technologies and the way we do consultative medicine, we entered into an experiment with US West a few months ago to attempt to do medicine via more conventional means—and I am going to show you more conventional means of advanced communications—using land lines, fiber optic lines, T–1 lines, and compressed video.

Now, you have my testimony, and I ask that you accept it at this point in time.

[The prepared statement of Dr. Tangalos follows:]

PREPARED STATEMENT OF DR. ERIC G. TANGALOS

Mr. Chairman, my name is Eric G. Tangalos, M.D., and I am Vice Chair of Mayo Foundation's Communications Committee. With me today is Ms. Sheryl D. Hill, Health Care Account Manager for US West Communications Services, Inc.

There are significant ethical, legal and jurisdictional problems to surmount regarding the long distance consultative practice of medicine and the delivery of medical services via telecommunication systems.

Multiple trials are underway on Mayo's campus, in the state and across the nation to explore various modalities to deliver medical services. Mayo experiments are ongoing from 386 Kbps with US West to 110 Mbps with NASA and the soon to be launched Advanced Communications Technology Satellite (ACTS). Policy issues and acceptable standards are an integral part of the evaluative process and a requirement for reimbursement. Cost, outcome, and liability will be equal determinants in decision making for the future.

In 1986, Mayo Clinic of Rochester, Minnesota, established major group practice sites in Jacksonville, Florida, and Scottsdale, Arizona. To maintain an integrated practice and a common philosophy, a significant commitment was made to invest in a communications system employing advanced satellite technology and equipment. Our approach is to provide consultative services to all three group practice sites via full-motion analog video. Three transponders on G-Star III now allow for two simultaneous-live programs linking all three group practice sites, nationwide.

The Mayo experience creates a seamless and transparent interface. We have been able to provide face-to-face consultations, review plain x-rays and angiograms, participate in speech therapy, and link distance sites during interventional procedures.

Our network has widespread acceptance among physicians and is also used for educational, administrative and research purposes. Regular surveys are conducted to judge the quality of the service. Guidelines have been established to determine user priority and extensive records exist documenting utilization rates by event, department and time.

In 1992, over 2,065 broadcast hours of telecommunication satellite activity were recorded, comprising 36,516 contact hours. Of this, 42 percent was for education, 40 percent for administrative uses, 9 percent clinical and telemedicine, and 9 percent for research. In addition to live satellite activities, in 1992 Mayo Video Communications Systems produced 839 hours of videotaped medical education programs, 206 hours of non physician medical programming, 100 hours of surgical procedure programs, and 9 major patient education programs.

Technology making telemedicine possible is evolving at exponential rates. Capabilities that seemed futuristic a few years ago are commonplace today. Potential uses of telemedicine are tremendous. Concurrently, the need to address the enormous proportions of national resources going into medical care in the U.S. and the inequities in access to care among different parts of our population, has reached a critical stage.

Mayo's research interests in telemedicine allow us to evaluate developing technologies and strategies necessary for healthcare providers to better serve their patients with integrated services provided on intelligent information highways.

The "Mayo Telemedicine Symposium" on October 1-3, 1993, will include a consensus conference funded by the Agency for Health Care Policy and Research (AHCPR) on "Telemedicine and Access to Care". We hope to explore the barriers to full utilization of telemedicine, propose initial steps to addressing these barriers and identity ways in which telemedicine is cost-effective as a tool for healthcare improvements.

It is important to America that national communications policy encourages technology providers to deploy service and support where it is most needed. The information explosion has surpassed the capabilities of our current regulated communications network. Limitations on the business opportunities of the telephone companies—whether bans of long distance service, research, design and manufacturing, or interactive video services—result in patients and healthcare professionals not having the full range of products and services that should be available to them.

In preparing today's demonstration, our most difficult hurtle to surmount was connectivity, or lack thereof, between local and long distance carriers. The interLATA restrictions greatly reduce our flexibility, responsiveness and creativity.

Our remaining time is devoted to a demonstration of our compressed video trial with US West. This Communications Program for Advanced Switched Services (COMPASS) trial uses a VTEL codec and fractional T1 transmissions. Equipment is located at three sites on the Mayo Rochester campus. One unit serves our Urgent Care Center, another serves the St. Mary's Emergency Trauma Unit, and the third assists our physicians at Mayo's Department of Orthopedics.

Multiple scenarios are presented. First we demonstrate an orthopedic problem submitted from the Washington site for consultation by our physicians in Minnesota. X-rays and simulated patients are examined remotely. Next we demonstrate skin problems using volunteers from the Washington audience for opinions from our consulting dermatologist in Rochester.

The attendees will be able to compare transmission modalities and experience real time use of currently available technology.

Dr. TANGALOS. I also want to thank you for having us today. I think the vision that you and Senator Burns have shown with regards to telemedicine and the delivery of services to rural and underserved areas is quite remarkable. The four States represented today are States who share the need to deliver services to the rural and underserved.

The experiments that we have ongoing are to attempt to do just that. With that, I would like to get about the practice of medicine, and we have four patients waiting today.

Our first patient—Sig, are you going to be doing this first?

VIDEO PHYSICIAN. Yes, I think I am.

Dr. TANGALOS. All right.

Our third patient today has a problem with a mole. She came to my office for consultation just a few weeks ago and was concerned about melanoma. Melanoma is a significant problem, and this par-

ticular patient was very worried about the mole. I could not answer the question, so I have asked one of our dermatologists to give us a hand.

Would you please join us here and we will have you meet Dr. Sig Muller in Rochester.

THE PATIENT. Good morning.

VIDEO PHYSICIAN. Good morning, ma'am.

Mr. Chairman, Dr. Tangalos, this demonstration that we are going to do today has really two parts. One is the first part, which is a viewing of the lesion close up as the eyeball, as if I were in the room, and the transmission of that picture. And then, part two, which uses a handheld instrument, a surface microscope, which provides modest magnification, and that picture can be transmitted as well.

It is the second part of the demonstration with the surface microscope, I think, that makes this technique—gives it its potentially great impact, particularly in rural areas, where there are less-experienced individuals, directly to hospital centers where there are more experienced individuals.

With that background, we can proceed to the examination of this mole.

Ma'am, could you tell me a little bit about the mole?

THE PATIENT. OK, yes. I have this mole on my chest, and I have been worried about it. I have been in the sun a lot. I am wondering if there is any problems with it.

VIDEO PHYSICIAN. Yes. Now, if we could have the camera move up close to the lesion so that I could get a better picture of that. It is not quite centered appropriately.

There it is.

Now, if we could just focus a little bit more, and try to hold still there a little bit, please. And just send that picture.

Here we have the pigmented lesion and our concern, of course, is for a malignant mole, or is this benign? The great majority of moles are benign, but over the last three or four decades, we have seen a significant increase in the frequency of malignant transformation, which continues to increase. So that, presently, it is estimated that the frequency of malignant melanoma in the general population approaches that of 1 percent in a lifetime.

You can see that the edges are rather sharp and that the coloration is rather even. However, this does not provide, usually, enough information for the clinician, the expert, to really determine. And so the use of a handheld instrument is necessary. And this is also called epiluminescence microscopy.

It is a surface microscope which penetrates the outer layer of the skin, called the epidermis, which is approximately .1 millimeters thick, or that approximately of a page. It permits you to look at the pigmented cells that produce this type of tumor at the basal layer of the epidermis.

So, if we could have the examination of the mole with the handheld instrument, the surface microscope.

Now, we can start at the top. There is the surface of the epidermis, and you can see that this is the outermost layer. And then, as we go deeper, focusing through the epidermis, you can see it changing—and that's perfect, send it. Beautiful.

Now, here I am going to just outline for you some of the characteristics that permit you to—well, at any rate, here you can see that it is relatively sharply outlined all around the surface here, and you can see the evenness of the coloration through the mole. You can also see some peripheral unevenness, but, by and large, it's rather sharply demarcated.

And I have good news for you, Marilyn. This mole has all the characteristics of a benign mole.

THE PATIENT. Thank you, Doctor.

VIDEO PHYSICIAN. And I think that the characteristics of the transmission are I think very close to that if I were in Washington in that room looking directly at this mole with my epiluminescence microscope, which has the same features as your scope there, but with the camera potential attached.

So this, then, is a picture that we have for the chart.

I should tell you that skin cancer is a very great problem in the United States at the present time. The numbers of skin cancers per year are about 600,000 per year, much greater in those who have had chronic sun exposure. This is particularly a problem in rural areas. And so, what it does, particularly for these pigmented lesions, which really requires a greater degree of expertise in their interpretation, it really connects the lesser-experienced healthcare provider with a medical center, where there is greater experience. And I think it definitely shows great potential.

Dr. TANGALOS. Sig, I had a second case for you. We have our first patient's daughter, Katy. Now that we were interested in her mom, Katy has a mole on her neck that she would like an opinion on. Now, she is younger than what I usually take care of, but would you help us out, please?

VIDEO PHYSICIAN. I would be happy to.

Dr. TANGALOS. Katy?

VIDEO PHYSICIAN. I am Dr. Muller, and this will not hurt at all. At least if you were here it would not hurt. [Laughter.]

It is going to be like a photograph, a camera that you take. And, essentially, I think if you were here in the office, what I would ask is: How long have you had the mole? Were you born with it?

THE PATIENT. When I was 4 years old.

Dr. TANGALOS. It is always tough when you have the mother in the examining room. We are getting a mixed story here. [Laughter.]

That is all right. Let us just go to the demonstration of it. If I could get the three-chip camera look at it.

Dr. TANGALOS. We are going to give you the overview first, Sig. This is what we are talking about.

VIDEO PHYSICIAN. Yes. And then if we could focus that there, and send it. And actually I see several pigmented lesions, but the ones that we are most concerned about are those that are generally 5 to 6 millimeters or larger. So what we have here is the mole that is a little bit larger and will be the focus of our main attention.

Now, then, if we could go to the handheld surface microscope for a little bit—now, there is no pressure need be applied. All that has to be done is to put it on the surface and to start at the surface, and if we could center that a little bit better. Perfect.

Then, if we could start going a little bit deeper now. That is fine. Send it.

This you can see the pattern here is a little bit different. But, nevertheless, it is very sharply demarcated. But what you see are pigment globules here. They are aggregates of pigment cells that produce the pigment that characterizes the cell that makes up this benign tumor. Which, in this case, is a pigmented nevus. And I think it has all the characteristics of a benign lesion.

Now, we are more concerned about pigmented lesions in young children that are congenital or appear at birth or shortly thereafter, particularly those that are in a size range of about 1 centimeter or so or larger. And there is some debate as to whether these lesions have an increased tendency to become malignant or not. And I cannot tell you which wisdom is correct at the present time.

I can tell you that my practice is that with this type of benign nevus, which here has the characteristics of a junction nevus, that can only be determined by a biopsy. But I can tell you that these characteristics are those of a junction nevus. And by feeling it, which I cannot do, of course, if there is any thickness to it, would indicate a component a little bit deeper.

But, generally, it is the surface component in the epidermis that is the important one for the clinician that determines whether he thinks it is benign or something that is more serious. So, I would say this is a benign lesion, but because of this controversy about congenital nevi and the size of it, maybe sometime in the next few years—and if these do become malignant, and there is a very low frequency of conversion—that sometime when the child is older it might be a good idea to have this removed. But there is certainly no urgency and you need not do it now.

Now, the smaller little pigmented lesions that were seen elsewhere in the neck, I think are not of great concern, but I would certainly look at in a more extended examination. And I am sorry, I ordinarily would not talk to a young person in this fashion, but I realize I am really talking to her mother. I am really talking to Dr. Tangalos, and I am really talking to all the distinguished individuals there watching this demonstration. And I am very pleased to have participated in it.

Thank you very much.

Dr. TANGALOS. Thank you very much, Sig.

One of the things that this particular part displays is that physicians that are out in rural practice not only get their patients taken care of, but they get their continuing education brought up as well. And we think that there is a great advantage to keeping physicians in the primary care setting when they are linked to tertiary care centers this way. It is a far more rewarding practice. It keeps you involved with what is going on. And it keeps you up to date with the newest technologies. You feel as though you are there.

Now, we ran a great risk keeping our third patient waiting today in doing this.

Thank you, Dr. Muller.

Senator ROCKEFELLER. I wanted to thank the Doctor and I also wanted to say that, generally speaking, mothers and daughters are wonderful. [Laughter.]

Dr. TANGALOS. I hope we have an orthopedist at the other end. We do. Dr. Topper is going to join us in just a second.

Our third patient has been so busy in Washington that he has been unable to get away for appropriate medical consultation. Today, when we were visiting, we decided that we would provide that consultation right here in these chambers so that Senator Burns would not have to travel for his healthcare.

Senator Burns, would you please join me now?

Senator BURNS. OK. No editorializing.

Dr. TANGALOS. That is your call, sir.

This is Steve Topper and this is Senator Conrad Burns.

VIDEO PHYSICIAN. Good morning, Senator.

Dr. TANGALOS. He has had problems with his hand, and he has difficulties in the base of his thumb. And you know, he complained about this to me. We have a series of x-rays from before that he just happened to have in his briefcase, and we will share those with you in a few minutes.

But would you like to go ahead and interview the patient?

VIDEO PHYSICIAN. Yes. Senator, how long has your thumb been bothering you?

Senator BURNS. Ever since it cleared up and we started playing golf.

VIDEO PHYSICIAN. OK.

Senator BURNS. No, it is a couple of years.

VIDEO PHYSICIAN. Was there an injury that precipitated this?

Senator BURNS. Yes, there was.

VIDEO PHYSICIAN. And what was that?

Senator BURNS. I sprained this thumb, turned it back.

VIDEO PHYSICIAN. OK. And has it been getting gradually worse for you over time, or staying about the same?

Senator BURNS. Well, no, it was just an average kind of sprain and knocked it out of shape I think. And then the swelling went down, but I guess there is a little bit of, at my age, probably a little arthritis setting in or something. I will let you make that determination.

VIDEO PHYSICIAN. Have you received any treatment for this up to now?

Senator BURNS. I have not.

VIDEO PHYSICIAN. OK. All right. Dr. Tangalos, I would like to direct you through an examination now. If you could first show me a picture of the Senator's thumb close up.

Dr. TANGALOS. Do you want the x-ray first?

VIDEO PHYSICIAN. No, not the x-ray, just if you put the Senator's hand up on the screen for me.

Dr. TANGALOS. We will put it right in here. It is easier to do, sir.

VIDEO PHYSICIAN. OK. Just have him turn his thumb up toward the camera for me.

That is it.

And then come out a little further on the plate so I can see the base of the thumb a little better.

Now, Senator, I would like you to point and show me exactly where your thumb hurts.

Senator BURNS. Right there.

VIDEO PHYSICIAN. Right in there. OK. There is a couple of things on my mind, Dr. Tangalos, and I would like to direct you through an examination now. What I would like you to do is take the Senator's hand.

Dr. TANGALOS. We are going to come this way. We are going to use the other camera now.

VIDEO PHYSICIAN. OK. And if you can give me a picture of this. That is it.

Now, take the Senator's thumb and put it in his palm, like that. And have him close his fist around his thumb. And then we will take the hand and move it toward the small finger.

That is it.

Does that bother him overly?

Senator BURNS. Well, it just hurts up there in that—right up there, yes.

VIDEO PHYSICIAN. Right in that area. OK.

Now, let us do this one. Let us have you take his thumb back out again, out of the palm. I would like you to grab the proximal phalanx of the thumb. And I would like you to apply an axial load, and then circumduct the thumb around a bit.

Dr. TANGALOS. While I am pushing in?

VIDEO PHYSICIAN. That is exactly right.

Dr. TANGALOS. OK.

VIDEO PHYSICIAN. How did that feel, Senator?

Senator BURNS. A little pain, but not much.

VIDEO PHYSICIAN. OK. All right, very good.

Dr. Tangalos, do you have an x-ray for me?

Dr. TANGALOS. Yes, we do. I would be happy to show you the x-ray. I have got two views. I have already looked at them. We have got the standard hand view. But I think you will do better off with the one lateral view here.

VIDEO PHYSICIAN. Can you light the base of the viewing screen, please?

Now, can you give me a closeup?

That is good.

Now, can you give me a little bit more of a closeup?

That is it, good.

Now, there seems to be a bit of a glare there. Do you have any other lights on in the room?

Dr. TANGALOS. We will have to go back on you a little bit, because we are going to catch that glare. So that is as good as we are going to get.

VIDEO PHYSICIAN. OK, that is it. That will be fine.

Why don't you go and send that to me?

I think this clearly demonstrates your problem, Senator. If you look on your x-ray, in this area right here at the base of the thumb, you can see that if you compare the space between this bone and this bone, right in here, compared to this space in this joint up here that looks more normal, you can see that there is a wide space between the bones here, compared to down here. You can see that this represents some degenerative arthritic changes in the base of your thumb.

And you can see over in this area here that there is a little bone spur, which is also very characteristic of the same problem.

Now, there are several treatment options for this. We could try some splinting or we could try a steroid injection. But, really, with this degree of degenerative changes, I think you would be best served by a surgical correction for this procedure. I think that the joints—the next most proximal joint here, between your scaphoid bone and the trapezium is looking pretty good. So, I think the surgical procedure would just involve this joint right here.

And we would be talking about either effusion or a arthroplastic procedure, and there are several different techniques for doing that.

Now, if you would like to put the picture of the Senator's thumb back up for me, I can show you where the incision would be on the thumb.

Dr. TANGALOS. Do you want him or do you want the x-rays?

VIDEO PHYSICIAN. Just put his thumb back up there.

Dr. TANGALOS. Sure.

Let us move it up just a little.

VIDEO PHYSICIAN. There you go. Just a little bit further out.

Senator BURNS. We have too many hands on this thumb. [Laughter.]

VIDEO PHYSICIAN. Turn your thumb up a little bit more toward the camera.

Fine. Why don't you send me that?

Generally, the incision that we would use for this would start down in this area, and curve up that side of the thumb, and come out here a little ways. So, it generally would be on the order of something along those lines.

And we would certainly be happy to do it for you here, Senator. [Laughter.]

Senator BURNS. We will wait until the golf season is over, then think about it.

Thank you.

Dr. TANGALOS. Steve, thank you very much.

VIDEO PHYSICIAN. You bet.

Dr. TANGALOS. With the Chair's indulgence, one of your staffers is in need of an opinion, too. We could stop at this point in time or give you a fourth case.

Senator ROCKEFELLER. First of all, I want to say that we generally also on this committee love Senators from Montana.

He is now going to have lunch with Hillary Rodham Clinton and take this right to her, I presume. First of all let me just say that I am going to have some questions about this when we are finished with our third demonstration, but it is extremely impressive. It has been very, very helpful.

Again, I want to thank not only Senator Burns but both the mother and daughter whose names I do not know, which embarrasses me, because they were both very helpful and somewhat brave, and helped all of us in the process of creating better public policy possibilities.

So, just let me thank you all of you, Dr. Tangalos, very much for doing this.

Now, if it is OK, I would like to go on to Dr. Julian Rosenman, and have you do your demonstration, sir. I do not mean to cut off or to rush along. I want to thank also the physicians who partici-

pated at the other end, because I did not get their names either. Would you do that for me, Dr. Tangalos?

Dr. TANGALOS. I will indeed.

Senator ROCKEFELLER. Dr. Rosenman.

STATEMENT OF JULIAN G. ROSENMAN, M.D., ASSOCIATE PROFESSOR, DEPARTMENT OF RADIATION ONCOLOGY, SCHOOL OF MEDICINE, UNIVERSITY OF NORTH CAROLINA

Dr. ROSENMAN. Thank you, Senator. I am Julian Rosenman. I am a radiation oncologist from the University of North Carolina. Radiation oncology therapy is one of the major methods for treating cancer, and I want to ask your indulgence today to take you through a little odyssey of the kind of research that I have done over the last 10 years that finally ends up with my being in this room.

[A slide was shown.]

Dr. ROSENMAN. And there is a little story here, and I want you just to relax and enjoy this if possible. It starts out about 10 years ago when I was lost in the physics department at the University of North Carolina looking for the bathroom, and walked into a graphics laboratory and saw this up on the screen. And I said to a couple of computer scientists there, Dr. Henry Fuchs and Dr. Pizer, what in world is that? And they said, you are a physician, do you not recognize a carotid artery? The carotid artery is the main blood vessel which goes up the side of the head.

And I looked at that and I suddenly realized that I did recognize that this was an artery, and it looked a lot more like an artery than, for example, this little white dot or that little white dot from which it came on the CAT scan. I got so excited when I saw this picture I said, "My God, this is a technique. It is a cure." The question, of course, is what is the disease. And I will hate to admit to this august body that medical research often does work backward, when you start with the cure and work backward and find the disease for which it fits.

I thought possibly that images and pictures like this could be useful in cancer management, although I had not clue as to how.

[A slide was shown.]

Dr. ROSENMAN. Now, just to refresh your memory, if you do not know about these things, in the early 1980's this was kind of the state-of-the-art of computer graphics. This is, in fact, the human brain, although to my mind it looks a little more like a brain on drugs.

[A slide was shown.]

Dr. ROSENMAN. By 1986 it was possible to take that same data set and make a picture that was like this, and is the right color and is kind of solid looking. But it still does not look an awful lot like a brain, perhaps a little bit more like silly putty.

[A slide was shown.]

Dr. ROSENMAN. In 1988, I had the great pleasure of working with Dr. Mark Leroy, who is now at Stanford University, who had just come back from his triumph at Hanna Barbera in manufacturing the Smurfs, if you remember that, and was looking to do some serious computer research. And I suggested that he take his talents to medical imaging. And in 1988 he produced this image from the

same data set, which I would submit to you looks a great deal more like a human brain than the other pictures that we saw previously.

Senator ROCKEFELLER. Doctor, I have to make an urgent phone call. It will only take me a couple of minutes. You go right ahead. I have people here who will explain to me exactly what you said, and the audience is waiting. I will only be 2 or 3 minutes, so please proceed.

Dr. ROSENMAN. OK. People who saw this image wanted to know—for example, the director of the anatomy lab wanted to know why I had taken a cadaver out without his authorization and taken a photograph of the brain. And I had to convince him that, in fact, this was a live and living person that you will see in just a few minutes, and brain was made from that data. So, this is not a photograph of a brain.

[A slide was shown.]

Dr. ROSENMAN. The problem with those kinds of images, besides still having no idea whatsoever of what we were going to do with them, was that they take a long time to make. A picture like that took about 30 minutes to make on a fast work station, and very often at the end of 30 minutes you had something that was not very useful or very interesting, and you had to start over again.

By 1989 my friend and colleague, Dr. Henry Fuchs, was working on his fifth generation graphics machine which he calls Pixel-Planes, and these remain the fastest graphics processors in the world. And one of the things that I was most interested in doing is seeing whether this very high powered parallel processing computer could be used to generate the images that you saw earlier, but much faster, perhaps even interactively.

[A slide was shown.]

Dr. ROSENMAN. By 1990 this was our first results. We are now about 3 years away from this. I call this particular person Helga, although that is not her real name. She lives and works in Chapel Hill, NC, and this is a reconstruction of a magnetic resonance scan done in three dimensions.

Now, you can do things to Helga electronically that the American Medical Association really does not approve of. For example, you can take an electronic scalpel and just slice a piece of her head off if you like, if that makes you feel good.

[A slide was shown.]

Dr. ROSENMAN. And you can slice it even deeper. These images are manufactured at the rate of about one per second. So, in a kind of jerky fashion you actually can interact with this image as if this were the person really sitting on the table.

[A slide was shown.]

Dr. ROSENMAN. You can twist it and rotate it, even turn it into what I have now called the guillotine position and look up her neck if you wish to do so. So, we now have the capability, by the 1990's, of taking those images that you saw much earlier and making them interactive.

[A slide was shown.]

Dr. ROSENMAN. But what might they be used for in tumor care? During the late 1980's, we gave a lot of thought to how images like this could be used in the treatment of cancer with radiation therapy.

Now, radiation treatment of cancer is really pretty simple in principle. You put the tumor in the radiation beam and then put four, five or six beams on the tumor from different angles so that the tumor gets four, five, or six times the dose of the normal tissue. That is called tumor targeting.

There is some very good evidence, I hate to say in front of this august body, that tumors are missed perhaps 30 percent of the time by practicing radiation oncologists. It is difficult to target tumors because you often cannot see them.

[A slide was shown.]

Dr. ROSENMAN. So, for example, this is a reconstructed x-ray of a patient's pelvis. Now, I say reconstructed because it is not a real x-ray, it has been computed from CT data. And let us suppose that you are going to treat this patient's prostate. Well, where is the patient's prostate? We know that the prostate sits somewhere around here on an x-ray, we know that from experience, but we do not know particularly for this patient. Well, the computer can put the prostate right onto this x-ray and do it just with the tap of a computer button.

And now there becomes no question whatsoever where the prostate is. It is very obvious and very clear, and you never saw an x-ray like this before.

[A slide was shown.]

Dr. ROSENMAN. It is also important to put radiation beams on from many different angles. But to do that you have to know where the radiation beam—what kind of tissue the radiation beam is going to pass through. And it is hard enough to understand the anatomy of a human being from a frontal view or from a side view, let alone from, as one of my friends calls, a cockamamie angle which comes in from the back of the head.

This particular patient had a brain tumor which you can see in purple there, and one of the beams that were chosen to use is one that entered through the back of the head and exited through the chin. We were able, in fact, to look down that beam—I cannot do that here because it is not interactive—and see all the different brain structures that that beam might pass through.

So, the use of higher quality graphics that we started out with by accident in 1983 now became an integral tool in tumor targeting and improving the quality of radiation therapy.

[A slide was shown.]

Dr. ROSENMAN. In addition to knowing where the radiation beams go when you treat a patient, you need to know what the distribution of the radiation dose is, which does not necessarily follow the beams. This is because we want high doses to the tumor and a low dose to everything else so far as it is possible to do that.

[A slide was shown.]

Dr. ROSENMAN. Here is a three-dimensional picture of a radiation dose on that patient. Most of the dose to the tumor is concentrated in or underneath that surface, and there one can see in a glance that the radiation dose to the chin or the eyes or some other things is really quite low. So, we have then developed the technique for both targeting tumors and displaying radiation doses.

[A slide was shown.]

Dr. ROSENMAN. We were left with a very embarrassing situation. We now had the ability to put radiation beams almost anywhere in a patient from almost anywhere, and understand what we are doing, but how do we find the best treatment for a given patient.

Now, unknown to us when we were confronting this very difficult issue in 1989, this issue was also being looked at at the University of Michigan and at Memorial Sloan-Kettering Institute in New York City, and to some extent at the Massachusetts General Hospital in Boston. So, we were not the only people dealing with this problem.

But at the other three institutions the people dealing with these problems were physicists, and at the University of North Carolina it was me, a physician. And so we took rather different tacks on this problem.

My desire was somehow if I could calculate the radiation doses as soon as I put the radiation beams on, then I could move the beams around and just kind of explore around, and find a good arrangement of radiation beams that would give a good dose distribution that would be good for the patient.

The trouble is with any of the computing resources available at a hospital it would take about an hour to calculate the dose distribution for each beam arrangement, and the patient would die before I would ever find a good way to treat them. It would take months. So, it remained wildly impractical, or so I thought.

[A slide was shown.]

Dr. ROSENMAN. In 1989 we were approached by a consortium from the Research Triangle Park that consisted of Bell South, GTE, and the Corporation for National Research Initiatives. They were looking for an application that might require a gigabit network to run.

The reason they were interested in this—and a gigabit network is a network capable of transmitting a billion bits per second across it. And this would be about 1,000 times faster than the T–1 line that was discussed earlier here.

They wanted an application that would require a gigabit network to prove that such a thing might be valuable. The reason they did this is because the National Science Foundation and DARPA, now ARPA, under an either pre-HPCC initiative or just beginning HPCC initiative, wished to fund five test bed sites to set up such networks for technical reasons, and could see what kinds of projects or applications could run on them.

So, they came to me and they said, "Do you have an application that would require a gigabit network?" And I said, "Yeah, boy, we sure do. Look at this." Supposing, sitting in my office here, I could be slinging these radiation beams around on a 3-D model of the patient, send the beam configuration off to the Research Triangle Park, which is about 15 miles from Chapel Hill, to the CRAY YMP, which was at the time, and perhaps still is, the fastest number crunching machine in the world and the only one in the State of North Carolina.

Then the CRAY would calculate the radiation doses, send them down to Pixel-Planes at Computer Science, which is about a quarter of a mile from the hospital, where they would be rendered into a 3–D image like I showed you a few minutes ago, and then send

this back to my desk so I could look at it and say, I do not like it, I am going to change the beam again and see what happens.

We could then build a system that would allow for rapid optimization of treatment plans for patients. And we presented this idea and it was accepted, and it was one of the five test bed sites that were funded. And the funding again comes from GTE, Bell South, and the NSF, and DARPA.

[A slide was shown.]

Dr. ROSENMAN. The project is now in its third year. I would like to show you some of the results and then tell you where we are going from here and how this might tie into some of the things discussed at the conference today.

This is a typical picture from VISTAnet. This is the torso of a patient, and prostate cancer seems to be a major target of 3–D dimensional treatment planning for reasons that I do not want to go into now. And this is kind of a traditional set up of four radiation beams on a patient. One in front, one on the left side, one on this side which you cannot see, and one from behind.

And if you were treated at any institution today for prostate cancer, except for the University of North Carolina, Michigan, or Sloan-Kettering that would be the kind of treatment you would get for prostate cancer. And you can see the prostate here in green on this CT cut, and you can see the radiation dose levels which sort of go around the prostate, but a lot of them go way out here in the pelvis. That pretty much is the state-of-the-art and the best that could be done.

[A slide was shown.]

Dr. ROSENMAN. This is the set up that we were able to work out using the VISTAnet for prostate cancer. You do not have to be a radiation oncologist to see that the radiation doses are very much tighter around the prostate than they were in the previous slide.

[A slide was shown.]

Dr. ROSENMAN. And in three dimensions it is even more obvious. Here is the traditional treatment, showing the doses going way out into the pelvis.

[A slide was shown.]

Dr. ROSENMAN. And here is the picture from the VISTAnet set up with this object in here being the prostate, and this kind of red film around it being the dose distribution.

So, we were able then to find a way, even in the early days of VISTAnet, of improving standard prostate cancer treatment. This is important because the National Cancer Institute has now put forth an initiative to see whether increasing the doses to prostate cancer by 20 percent will improve the cure rate of this disease. There are many skeptics who think it will not. I think it will.

Seven institutions have now been selected to study this. We are one of them, and it is perhaps even likely either this technique or a modification of it will be adopted as a standard technique.

So, what started off as a totally off the wall project with VISTAnet is now suddenly taking on some very practical applications.

[A slide was shown.]

Dr. ROSENMAN. But VISTAnet technology is still limited to my desk. There is 20 million dollars' worth of equipment on there and

it only comes to me. And this, in light of the idea, is probably not what Senator Rockefeller had in mind when he said we ought to cut costs.

Would it be possible, for example, to take the VISTAnet technology and make it available to everybody who is capable of running it? In order to do that we would have to take all of the computing and display power that was available in VISTAnet and convert it into a single machine.

By 1995, I believe it will be possible to do that. Computer hardware has caught up to the point where a single machine probably could do the job that it takes two machines to do now. In addition, we have learned a great deal about how to do this software because we have had these monster machines available to us.

The idea is once we do this we could then put this out over the North Carolina information highway, which is a high-speed network being built in the State of North Carolina, and make it available to hospitals outside of our own. And eventually, if the project is successful and high speed networking becomes available throughout the United States, we could make this available in Billings, MT or in Wheeling, WVA, or whatever other State might need it.

And so we are looking very hard at the idea of this three-dimensional radiation treatment planning which is technically very difficult, being able to export this through a network, and make it available to almost anybody at a very reasonable cost.

Now, there are a couple of things I wanted to say, Senator, to this panel. There are some political difficulties involved here that people do not seem to be aware of that are going to very quickly impinge on our ability to do this.

The first is that medical software is now considered a medical device and therefore is regulated by the FDA. We have no problem with that, but the FDA, the Federal Drug Administration, is not used to dealing with this kind of problem and really does not have the facilities for evaluating whether the software is safe or not. Furthermore, we cannot seem to get a straight answer from FDA as to whether we need this to be FDA-approved or not before we transmit it out over the network.

So, at the moment we do not know even whether we are breaking the law if we help patients and other hospitals with our software at the University of North Carolina. We are just not certain of what the status is or what we would have to do to make it legal. And I think that as telemedicine becomes more important this issue of FDA approval is going to have to be dealt with in some rational and efficient manner.

The second issue is the ugly issue of medical malpractice. We, I in particular, am willing to incur the risks personally of medical malpractice in helping physicians in other hospitals set up patients. But I am not too sure what the risks of the carriers and the phone companies are in this.

In the VISTAnet project at the very beginning we made the decision that no patient would be treated prospectively with VISTAnet because if something happened to the patient and there were a medical malpractice lawsuit and the lawyers found out that the phone companies were involved in this, the medical malpractice

suit might be astronomical. I am not sure about the liability if there were a glitch in the line and something did not get transmitted right and the patient were injured. What would the liability of the carriers be? And I suggest this may be a serious problem that will have to be dealt with.

[A slide was shown.]

Dr. ROSENMAN. Finally, just to push on, from the practical end we are also going into the ridiculous. This is a case of virtual reality which we are working on. This observer is actually in the space of this particular object, which is a human being. You see the breast there, the neck over here, and a big tumor in yellow, and he is throwing radiation arrows at it in his own virtual space. When you wear this device, Senator, you feel very much that you are in same room as this object, and you duck as those arrows swing around so they do not whack you in the head.

This looks to me very much like a cure looking for a disease, where I started 10 years ago. I have no idea what value virtual reality will be for cancer therapy, but only a sense that this is the kind of research that you have to do in order to get answers.

It is true that this is at first blush not the best way to cut a lawn—a little disorganized and rambling from side to side, but I think that scientific research is like this. You just cannot go straight from point A to point B without rambling through a lot of other things. And I am very pleased that our stuff would start off very off the wall and the pie in the sky is now a very practical thing.

[A slide was shown.]

Dr. ROSENMAN. The important thing is to look to where we have come from—60 or 80 years ago radiation oncologists were selling radium water on the street corner for acne and impotence and other problems, and since that time we have come a long way.

Thank you very much for your time, and I would be happy to answer any questions.

[The prepared statement of Dr. Rosenman follows:]

PREPARED STATEMENT OF DR. JULIAN GARY ROSENMAN

Before a cancer patient is treated with radiation therapy the treatment is modeled on a computer to determine what radiation dose will be absorbed by the tumor, and normal, non-cancerous tissues and organs. Irradiation of normal tissue in the path to the tumor cannot be avoided entirely, so the radiation oncologist takes great care to design a plan that keeps this unwanted radiation to a minimum. Until recently, all treatment planning was done in two dimensions because three dimensional treatment modeling was too compute intensive to be practical. In the last few years, however, a lew institutions have begun to use limited 3D treatment planning for some of their patients. However, we still do not know how to take full advantage of 3D radiation treatment plans as many promising ideas have not yet been explored due to limitations in available computer power. Thus, at best, patients are treated today with only partially optimized treatment plans.

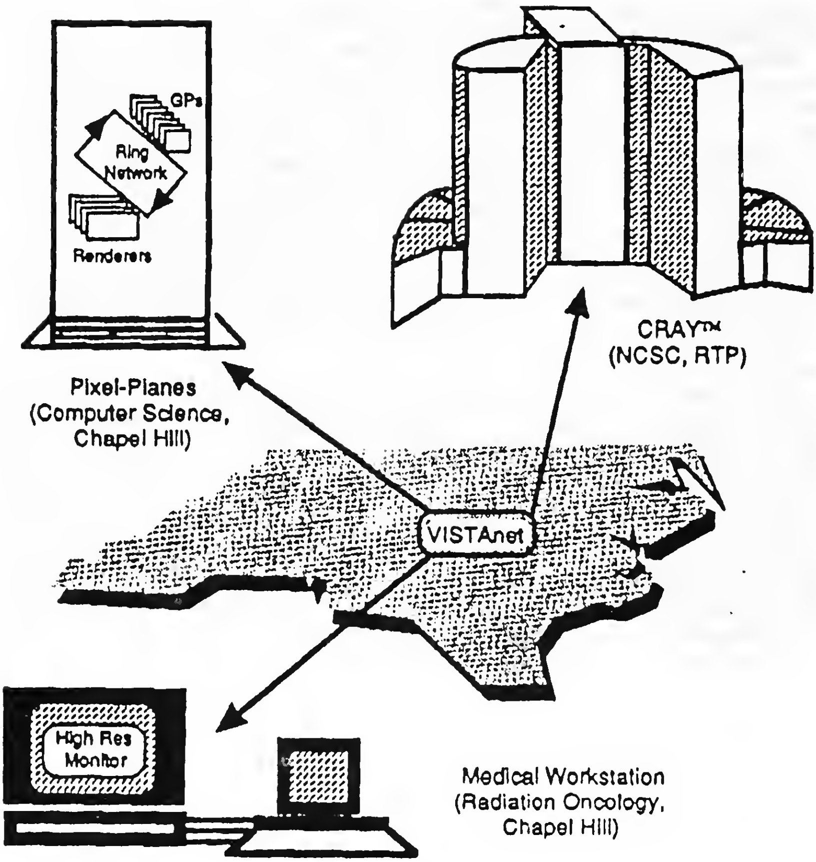
In 1989 a consortium of Radiation Oncology and Computer Science Departments at the University of North Carolina, BellSouth Corporation, GTE and the MCNC Center for Communications (MCNC) was formed to prepare a response to the high speed network initiative proposed by the National Science Foundation (NSF), and the Defense Advanced Research Projects Agency (DARPA) and coordinated through the Corporation for National Research Initiatives (CNRI). The initiative was aimed at developing the technology to boost computer networking speeds up to a gigabit per second (10^9 bits/second). This rate of data transfer is almost a thousand times faster than currently available and would provide the bandwidth necessary for near realtime (plus or minus 1 frame/second) interaction, from a remote site, with the most powerful computing equipment in the world. To accomplish this goal CNRI

proposed to fund several "test bed" sites where gigabit networks would be developed using driving problems that required this rate of data transmission.

Our consortium, known as VISTAnet, proposed to use real-time radiation therapy treatment planning as the driving problem. The plan was to develop a system that could calculate and display a three-dimensional radiation dose distribution for any number of radiation beams in less than a second, with no restrictions on beam angles or modifiers. (Such a calculation and display would take several hours or more on a conventional workstation.) To accomplish these tasks in an interactive manner, the radiation doses would have to be calculated on a CRAY YMP class supercomputer, and the resulting data rendered on special purpose graphics hardware if this system could be built, however, the user could quickly search through potential radiation treatment plans as fast as they could be specified, with immediate feedback as to whether a given modification made the plan better or worse. Thus the overall medical goal of the project was to allow the user to rapidly arrive at a highly optimized radiation treatment plan in a reasonable amount of time.

In the fall of 1990 it was announced that five test bed sites would be funded, including the VISTAnet project.

Each group in the consortium worked on a different task. The Radiation Oncology group developed the fast accurate radiation dose code that could calculate a three-dimensional dose grid in less than a second on a CRAY YMP supercomputer. In addition Radiation Oncology provided the appropriate user interface. Computer Science provided the hardware and software needed to visualize the amount of data that poured from the CRAY, and the hardware interface between the high speed network and Pixel-Planes, the high-speed multi-processing graphics computer developed in that department. MCNC provided the CRAY support, and developed interface boards between the high speed network and ordinary workstation, MCNC also provided administration for the project. Finally, BellSouth and GTE were responsible for providing the networking hardware and high speed cable to link the CRAY, Pixel Planes, and the computer workstation in Radiation Oncology. The overall VISTAnet architecture is shown on the following page:



The VISTAnet arrangement, RTP (the Research Triangle Park) is located about 15 miles from Chapel Hill. Computer Science and Radiation Oncology are about 114 miles apart. The radiation beams are set up on the medical workstation. The doses are then calculated on the CRAY YMP which sends the data to Pixel-Planes 5 which renders it into a 3D image, which in turn is displayed back at the medical workstation. The entire cycle of beam placement, dose calculation, volume rendering, and final display takes about a second. This process might take an hour on an ordinary workstation, and thus could not be interactive.

In the first 2½ years of the project we have built a high speed ATM based network that is now functioning near its specified level. This network is now serving as a prototype for studying many aspects of near gigabit speed communications. We have also developed very fast, accurate radiation dose code that can provide a complete 3-dimensional plan in a second or less on a CRAY YMP supercomputer, and have built interactive volume visualizations for anatomy and dose levels that push the state-of-the-art in computer graphics.

In our third year of this project we used the VISTAnet technology to optimize 3-D radiation treatment planning for prostate cancer. Using basic principles of solid geometry to maximally separate the radiation beams and thus reduce overlap on exit or entrance we have developed treatment plans that can deliver a higher dose of radiation to the prostate cancer without overdosing normal tissue than is possible with conventional techniques. It, of course, remains to be proven that these techniques are clinically feasible.

By the end of the project we will have demonstrated how multiple computers, linked with a gigabit network can solve a problem (real-time radiation treatment planning) that no single computer can. This effort, then contributes to the concept of "metacomputing" wherein different, specialized types of computers can be linked

together by high speed networks. And finally, we have demonstrated that medical imaging in general, and radiation therapy treatment planning in particular is a worthy application of gigabit networks, supercomputers, and advanced computer science concepts.

Senator ROCKEFELLER. Dr. Rosenman, thank you very much. And let me say that I am very glad that you had to go to the bathroom that day. [Laughter.]

In the interest of time I may have questions for all of you, and I am sure the other Senators do, which I may write to you and I hope within a reasonable period of time, which around here is usually 2 or 3 weeks, that you might be willing to answer them.

But one very specific one for you, Dr. Rosenman. With regard to the Federal High Performance Computing Program, and particularly the grant from the Corporation for National Research Initiatives, how fundamental was that to what you have been describing to us?

Dr. ROSENMAN. Without that, none of this would have been possible. When we had conceived of the idea of doing real time radiation treatment planning, we had despaired as to how it could be funded.

The National Cancer Institute does not like to fund things with computers, and certainly nothing as speculative and far-out as this. The National Science Foundation indicated it was medical, so we should talk to the NIH, and the NIH said to talk to the NCI, and in fact we were going almost nowhere with this until this HPCC became available, and HPCC simply cut across interdisciplines. It did not care so much about that. It wanted to develop the computer technology, and we rode along with that, so without that start we would have gone nowhere with this.

Now, we will see whether the NCI will fund the project to put it all into a box. We will see what happens.

Senator ROCKEFELLER. Interestingly, I think that one of the results of all of this attention now being paid to healthcare reform is not just simply the delivery of service and the quality of service and the cost of service, but also the coordination within the Federal Government of how we do things. I mean, what you have just said is classically typical, and I think it is partly a result of benign neglect over a very long period of time, and I think that the period of benign neglect has come to an end.

I think part of our job should be to help you do what you are doing, always with the words "interoperable" and "costsaving" at least in mind. Not everything in public policy can be defined as good if it saves costs. Sometimes you have to pay more to do more, and of course I understand that.

Each of you has made an enormously significant contribution this morning, and I regret, again, that we cannot pursue this further, but we have another very interesting panel, and they have their rights, too, so may I just thank all of you very, very much.

I would like to call now our third panel, which is Dr. James Brick from West Virginia University School of Medicine and second Mr. James Reid, who is a physician's assistant project director, Eastern Montana Telemedicine Project, of Billings, and Dr. Robert Flaherty, who is the project director of the Virtual Medical Center in Montana, in Bozeman.

Gentlemen—if we could have quiet, please, in the hearing room—we are very glad that you are here, and I guess, Dr. Flaherty, you are in the center, so we will start with you.

STATEMENT OF ROBERT FLAHERTY, M.D., PROJECT DIRECTOR, THE VIRTUAL MEDICAL CENTER, MONTANA AREA HEALTH EDUCATION CENTER, MONTANA STATE UNIVERSITY

Dr. FLAHERTY. Thank you, Senator Rockefeller. What I wanted to speak about today is a different kind of telemedicine project that we have been working with since 1988 in the State of Montana.

Senator ROCKEFELLER. This is generally going to be about innovation in the States, all three of you, so the audience should know that. Please proceed.

Dr. FLAHERTY. Thank you. What I am talking about today is what we call the Virtual Medical Center. This is a computer bulletin board system for health professionals which is designed to provide a number of health-related information services to primarily rural health professionals, a group that we all recognize as being often geographically and professionally isolated.

The Virtual Medical Center is designed so that any health professional using any computer, modem, and standard copper wire voice telephone line can call into the system. There are no subscription charges or connect charges, and in fact there is a toll-free 800 number that allows health professionals in the States of Washington and Montana to call into the system. Soon, we hope to be accessible via the Internet throughout the world.

The VMC uses the metaphor of the university medical center, which is a very rich environment for learning. We do not have a university medical center in Montana, so we have attempted to create that collegial environment inside a computer. Hence the name, the Virtual Medical Center.

Within that environment, we hope that all types of health professionals can share information and engage in many different formal and informal educational activities. One major feature of the Virtual Medical Center is electronic mail messaging. These messages can be left and retrieved down at the Virtual Medical Center either as public messages which are readable by all callers into the system or as private messages readable by only one, or a few designated addressees.

We have different E-Mail areas on the Virtual Medical Center for different topics related to healthcare. For instance, we have areas related to rural health, public health, family practice, nursing, aids, and even legislative issues, and I might say that Senator Conrad Burns has used the Virtual Medical Center E-Mail facilities to communicate with Montana health professionals and gather their opinions on health reform topics and on telecommunications.

In addition to the general discussions that are available on the E-Mail aspect of the Virtual Medical Center, we also provide clinical consultations. For example, callers can leave messages for the pharmaceutical faculty at the University of Montana School of Pharmacy and Allied Health Sciences asking questions relating to pharmacy and pharmaceuticals and therapies such as side effects and drug interactions, and even treatment protocols.

The faculty from the School of Pharmacy then search through their considerable information resources, find the answer, and leave an E-Mail message for the health professional generally within 24 hours.

Another example: Health professionals without easy access to medical library services can leave E-Mail messages for medical librarians who call in on a rotating basis to pick up these messages. These requests are for such things as literature searches and document delivery, and in this way rural health professionals without access to medical libraries can indeed get the most up-to-date information to help care for their patients.

In addition to the E-Mail capabilities of the various conferences, we also have file areas on the Virtual Medical Center which contain health-related files. These are usually word processor files or documents which can be read by any word processor. These files can be read on-line, or they can be downloaded into the caller's computer. That is, copied for future use.

For instance, currently we have files that relate to health-related newsletters, diagnosis and treatment recommendations, public health advisories, health information resources, health legislation information, and even continuing education courses.

As an example, during the recent fatal food-borne illness epidemic in the State of Washington, and during the recent hantavirus epidemic in the American Southwest, information files describing diagnosis and treatment of these diseases were available on the VMC directly from the CDC information sources and were available to all health practitioners. I am pleased to say that that information was available within 24 hours of its release by CDC.

Other files at the Virtual Medical Center include continuing education courses which can be particularly useful for rural health professionals who find it difficult to leave their practices to update their knowledge.

The Virtual Medical Center staff and St. Vincent's Hospital and Health Center in Billings have developed inexpensive but effective on-line continuing education courses for physicians and nurses. In addition, the Virtual Medical Center has worked with American—

Senator ROCKEFELLER. I need to have you explain that last a little bit more fully—in other words, how you update knowledge, and then how they could obtain that—various physicians, physician's assistants. Could you explain how that works?

Dr. FLAHERTY. What we have done is, we have developed a modality that includes a text file, basically a journal article specific to the topic. We have, for instance, articles with diabetes update and geriatrics update, and a cardiology update. These have been provided by this hospital relative to the courses that they have offered in lecture format. We then develop these in written textual format and add to that a post test and a registration form.

The caller to the Virtual Medical Center can download that word processor file and at their leisure read the course, fill out the post test and the registration form, and mail the post test and registration form, for instance, to St. Vincent's Hospital for credit for continuing education.

What we hope to do very shortly is to have a graphical——

Senator ROCKEFELLER. As we come out with practice guidelines, and as there begins to be, as there inevitably will be, somewhat more standardization of procedure, the question I want to ask you is, have you developed that within your State? Is it not more desirable that we work toward something which is national in its scope, or are Montana and, for example, West Virginia different enough in their ruralness that there needs to be variation and this information should be done State by State?

Dr. FLAHERTY. No, I think this can be national information. In fact, Senator Rockefeller, we are now working with the HCFA office in Seattle to provide regional information, just along those lines.

With the new approach from HCFA, educational rather than punitive activities toward physicians, they are quite interested in using this technique, which is very inexpensive and virtually universally available, for providing that kind of education, and that is an important point.

This system resides in Bozeman, MT, but the very technology means that you can call from anywhere in the country, and in fact we have callers from all States as well as the United Kingdom and Canada.

Senator ROCKEFELLER. Thank you.

Dr. FLAHERTY. Let me proceed past, then, the continuing education idea to tell you some other things that this technology can be used for. Sanitarians in the State of Montana are uploading onto the Virtual Medical Center text files, copies of wastewater, air and water quality regulations that they have developed for their counties. Other sanitarians in other counties are downloading that information into their word processors, customizing it for their county, and then publicizing their regulations.

What we are doing is not reinventing the wheel, but we are allowing some improved regulations and certainly improved public health to counties that just have not been able to develop those regulations yet. I think this information sharing is the key point of the Virtual Medical Center concept. I am not putting those regulations on. Sanitarians who found them successful are uploading them for their fellow sanitarians to use.

Now, most of the conference, E-Mail, and file areas on the Virtual Medical Center are public and available to all callers, but we also have set up some private, dedicated conference areas for certain health professional organizations. These private areas are only available to the members of those organizations and are transparent to the other Virtual Medical Center users.

For example, we have set up a network linking 40 county health departments in Montana with the Montana Department of Health and Environmental Sciences located in Helena. This private Montana public health network is being used for policy development, policy dissemination, and education of rural public health professionals, as well as for notification of disease epidemics.

We have also developed, with the State epidemiologist, a method of using this technology to electronically analyze and investigate epidemics, such that we are able to cut the time between the identification of an epidemic and the analysis and understanding and intervention in that epidemic, as well as decreasing travel costs.

In addition, the DHES is now gathering routine public health surveillance data electronically by having it uploaded by these 40 counties onto the Virtual Medical Center private area and downloaded into Helena, so we are getting routine surveillance information uploaded much more quickly, and in a digital format that is easy for the health department to analyze and understand.

I would also mention that a project that is peripheral to the Virtual Medical Center but has come out of our work with the bulletin board technology is the creation of very inexpensive teleradiology systems capable of sending high quality x-ray images between rural sites and larger medical centers.

These are still images, not video images as you saw today, but these images can be transmitted rapidly over standard copper wire telephone lines, not fiber optic, not T–1, and we use off-the-shelf hardware and software and the equipment and transmission costs are well below that of existing teleradiology systems.

We talked about standards earlier. We are using simple standards that are universally available, like ASCII text standards for our files, and simple GIF file standards for image transmission, and that is what I think helps to keep the cost down.

Senator ROCKEFELLER. I am sorry, I do not know what GIF is.

Dr. FLAHERTY. That is an image transfer, an image encapsulation format that has been popularized by CompuServe, and it is a way of placing and digitizing an image in such a way that it can be easily transferred over telephone lines. If any of these standards are nearly universal, this is a nearly universal standard.

I would like to give you some statistics on the Virtual Medical Center.

Senator ROCKEFELLER. I want you to do that, but I want you to do that within about 2 minutes.

Dr. FLAHERTY. Yes, sir, I will. They are straightforward statistics.

We have had, for instance, in the last 6 months 632 new users. These are not just physicians, but all health professionals. We have had over 9,500 telephone calls in that 6-month period, and we are now averaging 100 telephone calls a day into the system.

Let me just mention very briefly some of the barriers to the system, a few of which have been mentioned, but I think the barriers to the use of computer bulletin board technology are philosophical, technical, and regulatory.

Philosophically, what we have seen today as telemedicine I think is only a part of telemedicine, for telemedicine is now being thought of mostly as videomedicine, but I would submit that a lot of health-related information can be transmitted through this bulletin board technology, and that is the point I have tried to make with the examples that I have given today, and I would hope that you would take into consideration encouragement of this kind of technology as we proceed into our high performance computing initiatives.

Additionally, we need to educate people in how to use the things we have talked about today. I do not see anywhere in there where health professionals are taught or are going to be taught to use this system. Only 5 percent of family physicians use computers to ac-

cess medical information right now. That came from an AAFP survey done 2 years ago.

One other problem is nowhere do I see that we are really sitting down as a society and considering what information means to us. I mentioned in an E-Mail message that I found a very interesting article on cost-effective rural obstetric care, and many members of our Virtual Medical Center wanted me to scan it and upload it but I could not because of copyright concerns.

We as a society need to understand who owns information, how information can be accessed, and security issues as well, as well as the ramifications of this vast amount of information that will be available. We as a society do not know what that will mean.

Let me just mention very briefly our major technical problem is not necessarily line speed so much as line noise, the pops and hums that you hear on phone lines, particularly in rural areas. There ought to be ways that we could improve existing telephone systems with things like digital switching short of fiber optics, which I guarantee you are going to take more than 10 years to get into rural Montana, despite whatever efforts we might try in this area.

Let me just mention a couple of regulatory problems that have personally affected the Virtual Medical Center which you, I think, have direct control over, sir. One is the "modification of final judgment" that limits the ability of US West, our carrier in Bozeman, to help me develop modifications to the Virtual Medical Center.

I tried to put high-speed modems on my system and they would have liked to help me, but they thought that they were legally prevented from doing that. We need to decrease those barriers.

I also get a sense that part of the line noise problem that affects telecommunications with computers and modems relates to the fact that we have artificial LATA boundaries that have been set up. This means that a phone call from Kalispell, MT to Bozeman, MT may take as many as three carriers to connect. I think that needs to be changed.

In summary, sir, the Virtual Medical Center is a different kind of telemedicine. It is a computer bulletin board system that provides a lot of different kinds of medical and health-related information to all kinds of health professionals. It does it easily, it does it inexpensively, and it does it effectively using affordable, readily available, current technology. I would urge the subcommittee to keep this kind of technology in mind as it supports telemedicine in general.

I would like to thank you and the subcommittee for this opportunity.

[The prepared statement of Dr. Flaherty follows:]

Prepared Statement of Dr. Robert J. Flaherty

WHAT IS THE VIRTUAL MEDICAL CENTER?

"The Virtual Medical Center" (formerly HEALTHCON) is a computer bulletin board system for health professionals, developed and maintained by the Montana Area Health Education Center in Bozeman, Montana. HEALTHCON had been in continuous operation since November 1988 and had served over 350 health professionals who placed over 10,500 calls to the system to obtain continuing education courses and other health-related information. On January 18, 1993, HEALTHCON was replaced by "The Virtual Medical center" (the VMC), a much expanded com-

puter bulletin board system which offers many more features and services to a broader professional and geographic audience.

The VMC is a project of the Montana Area Health Education Center, the Montana Office of Rural Health, and Montana State University. The VMC is funded by grants from Merck & Co., Digital Equipment Corporation, the US Public Health Service and the Federal Office of Rural Health Policy.

WHOM DOES THE VMC SERVE

The VMC is designed to provide a number of health-related Information services to rural health professionals, a group often isolated geographically and professionally.

Initially developed for health professionals in Montana, the VMC expanded to serve Washington state in late 1992. The VMC is now accessed by health professionals, health educators and health policy makers from the entire United States, Canada and the United Kingdom.

Any health professional can call the VMC computer using any computer, modem and standard copper-wire voice telephone line. There are no subscription or connect charges, and a toll-free. (800) telephone number serves Montana and Washington state. The VMC will soon be accessible via the Internet.

THE UNIVERSITY MEDICAL CENTER METAPHOR

A University Medical Center is a rich environment for learning. Since Montana lacks a University Medical Center, we have tried to create that collegial atmosphere inside a computer, a "Virtual Medical Center" where health professionals of all types can share information and consultation, and many kinds of formal and informal learning can occur.

The VMC is organized like a University Medical Center in many ways. The Conferences and File Areas are divided into Clinical Departments, Specialty Clinics, and Medical Center Services. Bulletins and Questionnaires are also offered on-line.

SERVICES AVAILABLE ON THE VMC

Conferences are mailboxes where electronic mail messages may be left and retrieved. These e-mail messages can be either public to all callers, or private to one or a few callers. Each Conference is devoted to a particular topic, such as Rural Health, Public Health, Family Practice, Nursing, AIDS, Alzheimer's Disease and Legislative Issues.

In addition to sharing general information, e-mail is used for clinical consultations. Far example, callers can leave e-mail messages for faculty at the University of Montana School of Pharmacy and Allied Health Sciences in Missoula, requesting information relating to pharmaceuticals and therapies, such as drug interactions, side effects and treatment protocols. These faculty then use their extensive information resources to identify the needed information and respond by e-mail, generally within 24 hours. In this manner, rural health professionals can access important information resources that are otherwise unavailable to them, while the University of Montana is able to serve Montanans better. Examples of some typical clinical consultations are in Appendix A.

As another example, health professionals without easy access to medical libraries can leave e-mail messages for medical librarians to request medical library services such as literature searching and document delivery.

In addition to the e-mail capabilities of the various Conferences, File Areas contain health-related files. These are usually articles (word-processor files) which may be read by any word-processor. Files may be read on-line or may be copied (downloaded) into the caller's personal computer. Available files include health-related newsletters, diagnosis and treatment recommendations, public health advisories, health information resources, health legislation information and continuing education courses.

For example, files are available on the VMC describing the latest diagnostic criteria for AIDS from the CDC as well as lists of resources available to AIDS patients. During the recent fatal food-borne illness epidemic in Washington state, and the recent hantavirus epidemic in the American Southwest, information files describing diagnosis and treatment were available on-line.

Other files on the VMC provide continuing professional education, which can be particularly useful for rural health professionals who find it difficult to leave their practices to update their knowledge. The VMC staff and St. Vincent Hospital and Health Center in Billings, Montana have developed inexpensive yet effective on-line courses for physicians and nurses. The VMC is also working with the American

Academy of Family Physicians to develop enhanced continuing education courses for primary care physicians on the VMC.

Several hundred such files are available to all callers, and callers are encouraged to upload files to the VMC computer which other health professionals might find interesting and useful. For instance, sanitarians are uploading onto the VMC copies of their local air quality, water quality and waste water regulations, which other sanitarians are downloading into their personal computers and customizing for their local conditions. in this manner, effective regulations can be shared, improving local public health without "reinventing the wheel."

Most of the Conferences and File Areas on the VMC are public and available to all callers. The VMC also provides private, dedicated Conference and File Areas for various health-related organizations. These areas are only available to designated members of a particular organization. For instance, the Montana Department of Health and Environmental Sciences uses such a network on the VMC to link 40 county health department offices with the DHES in Helena. Members of the."Montana Public Health Net" have access to all of the public activities on the VMC, as well as a separate, highly secure private Conference and File Area which is used for DHES business. Callers to the VMC who are not members of the "Montana Public Health Net" do not have access to these dedicated areas, and indeed, are not even aware that the "Montana Public Health Net" exists.

The members of the "Montana Public Health Net" have used this network to conduct administrative activities such as policy development, policy dissemination, training of rural public health staff, and notification of epidemics. The Montana State Epidemiologist and the VMC staff have developed a method to identify and analyze epidemics using this "Montana Public Health Net" on the VMC, which can shorten the time required to investigate disease outbreaks while decreasing travel costs. Additionally, routine public health surveillance data is now collected by DHES electronically via this private network.

Other private dedicated networks on the VMC include:

The Montana Mental Health Net—Linking all mental health agencies, clinics and hospitals in Montana

The Montana Aging Network—Connecting the state Office of Aging with local offices

The Montana Consortium for Excellence in Health Care—Linking 12 rural Montana h6spitals to improve rural nursing care

The Columbia Basin Hospital Council—Connecting 8 rural Washington hospitals for mutual assistance and hospital survival

The National Association of WIC Directors—Connecting the state directors of the "Women, infant and Children" nutrition program

The National AHEC Center Directors Association—Linking 120 AHEC Centers and Programs nationwide

United States Senator Conrad Burns and his staff use VMC e-mail to communicate with Montana health professionals on issues of healthcare reform and telecommunications. Senator Burns has also uploaded to the VMC the text of several bills before the Senate and requested comments by VMC users.

One capability of the VMC is the transmission of digitized images. As a project peripheral to the VMC, we have adapted computer bulletin board technology to create very inexpensive computer systems capable of sending high-quality xray images between rural sites and larger medical centers. These images can be transmitted rapidly over standard copper-wire voice telephone lines using "off-the-shelf" hardware and software, and with equipment and transmission costs tar below those of current teleradiology systems.

STATISTICS

The VMC replaced HEALTHCON on January 18, 1993. Over the VMC's first six months of operation there have been: 632 new users; 9459 calls (now averaging 100 calls per day); 6480 messages left by callers; 749 files uploaded; and 1740 files downloaded.

Annual Budget: $75,000.

Staffing: 1.5 FTE.

BARRIERS TO USE

The bulletin board technology that the VMC uses is not particularly sophisticated, in that it uses readily available computers, modems and standard copper-wire voice telephone lines which exist everywhere in the United States. The few major barriers to expanded use of the VMC, and similar computer bulletin board technology, are philosophical, technical and regulatory.

PHILOSOPHICAL BARRIERS

1) "Telemedicine" has, for the most part, come to mean "video medicine" or high-speed data networks. These technologies are expensive and "site-bound" in that they require sophisticated equipment at both the local and remote sites linked by high bandwidth lines. Despite their "high-tech" cachet, video and high-speed networks are not necessarily the optimum way to send many types of medical information.

Recommendation: Video and high-speed/high-capacity technology do have a place in medicine, but more emphasis should be placed on encouraging the development and use of simple, inexpensive, effective and currently available technology such as is used by the VMC.

2) A study by the American Academy of Family Physicians in 1991 found that 57 percent of physicians had access to computers, but only 10 percent of those used computers for information access, such as via MEDLINE. As we plan for a universally accessible nationwide information network, we must also plan for educating and encouraging all citizens to use the technology.

Recommendation: Health professionals should be encouraged to obtain and use computers and modems to access information services.

3) Our society must develop new ways of understanding and managing information. For example, in a public e-mail message on the VMC, I mentioned reading a particularly useful medical journal article on cost-effective obstetrical care. Several callers asked me to scan the article and upload it to the VMC for others to read. I declined, citing copyright restrictions. Before we dream and plan much further for a nationwide "information superhighway", we must address issues of information ownership, access to information, the effect of information on rule, power and authority, and the ramifications of the collapse of information monopolies such as governments and the traditional media. Appendix B includes a copy of "The Twilight of Hierarchy: Speculation on the Global Information Society" by Harlan Cleveland, and I recommend it to this Subcommittee as an excellent discussion of many of these issues.

Recommendation: While planning our new information infrastructure we must make a priority of developing new information management policies.

TECHNICAL BARRIERS

1) Line noise, the pops, hums and crackles occasionally heard on voice telephone calls, plays havoc with modem telecommunications, causing transmission errors and limiting the speed at which modem-to-modem information can be sent. Although the major long-distance carriers have dealt with this problem admirably, many small and rural telephone companies still have older equipment which is prone to line noise and slow speeds. For example, I can often tell where the thunderstorms are in rural Montana at any given time by the amount of line noise experienced by callers to the VMC. I am told that this is primarily caused by water leaking into the telephone lines which changes the transmission characteristics.

Recommendation: It will be a long time before fiber optic telephone lines and sophisticated telephone switching equipment will be common in areas such as rural Montana. Until that time, we should encourage improvement of existing telephone systems to optimize currently available modem technology.

REGULATORY BARRIERS

1) US WEST serves most of the callers to the VMC, and US WEST has been understandably interested in the technology and success of the VMC. However, the "Modification of Final Judgment" in United States v. AT&T prevents US WEST from assisting or even advising me in the design and development of the VMC. For example, I recently added several high-speed modems to the VMC, but US WEST was unable to advise me as to the technical modifications that would be necessary.

Recommendation: The "Modification of Final Judgment" restrictions impede the development of inexpensive telecommunications systems like the VMC, and should be removed.

2) The current Local Access and Transport Area (LATA) structure now prevents local carriers from completing calls across LATA boundaries. This means that a telephone call between Bozeman and Kalispell, Montana might require connecting to as many a three carriers. These multiple connections could make modem connections more complicated and prone to error, and may contribute to the line noise problem described above.

Recommendation: Arbitrary divisions of telephone service areas which can make telephone connections complicated and prone to error should be removed.

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[Appendixes A, B, and C may be found in the committee's files.]

Senator ROCKEFELLER. Thank you, Dr. Flaherty. Just a quick question. As you mentioned 5 percent, I am not sure whether you said of family physicians——

Dr. FLAHERTY. That is correct, of family physicians.

Senator ROCKEFELLER. Are you aware as to whether, in your State or others, computer literacy is being required?

Is it being required for health-care professionals of all sorts in their training?

Dr. FLAHERTY. In our State we do not have very many training programs. We do not have any physician training programs except as relates to the WAMI program. In the nursing school there is no training program, neither is there in the pharmacy school.

Nationwide, there are some efforts going on, and there was a study that I had read that indicated that there were some early efforts. Clearly, the younger physicians are the ones that are the most comfortable with this technology, and I suspect it is because they are——

Senator ROCKEFELLER. Where do you think that age cutoff is?

Dr. FLAHERTY. Where do I think that age cutoff is?

Senator ROCKEFELLER. Yes. The difference between those who are comfortable with computers and those who are not?

Dr. FLAHERTY. I am not sure. I would guess it is about age 35.

Senator ROCKEFELLER. That is incredibly important. I mean, again, we do not teach preventive medicine at our medical schools. And all of this is terrific, but if we do not teach preventive medicine, if we do not teach people how to assume computer literacy, and all of what we have seen today and all of what goes on presently becomes harder to defend.

Dr. FLAHERTY. If I might mention one other thing, perhaps the most impressive medical information technology that has happened, I think, in the last decade, belongs to Dr. Lindberg with the Grateful Med program where end users are able to access the National Library of Medicine. I use that in my practice daily, literally, to sit down at the computer with a patient and do literature searches together. And that is, I think, the kind of approach we need to take to helping health professionals use this technology.

Senator ROCKEFELLER. Senator Burns, a fellow Montanan.

Senator BURNS. Do I understand we have two more witnesses or one?

Senator ROCKEFELLER. We have two more witnesses.

Senator BURNS. Two more to go.

Senator ROCKEFELLER. One West Virginia and one more Montana. We will just go to Dr. Brick, then. If you would go ahead, sir.

STATEMENT OF JAMES E. BRICK, M.D., ASSOCIATE PROFESSOR OF MEDICINE, WEST VIRGINIA UNIVERSITY SCHOOL OF MEDICINE

Dr. BRICK. Thanks, Senator Rockefeller.

Senator ROCKEFELLER. And pull that mike right up, yes.

Dr. BRICK. Usually I get accused of being too loud. I have a prepared statement which I sent along to you, and I am going to abbreviate that this afternoon.

I just want to say something about our program, MDTV, which is at West Virginia University, the Robert C. Byrd Health Sciences Center. It is in Morgantown. The central mission of the Robert C. Byrd Health Sciences Center is service to the State of West Virginia. West Virginia, as you know, is a State of approximately 1.8 million people, and we have about 3,000 doctors, 63 hospitals, and over one-half of those have less than 100 beds. It is a very rural State.

Because of its terrain and the distance to urban areas, recruitment of primary care physicians to rural West Virginia is a very real problem for us. In order to reduce the feelings of professional isolation and to increase the retention of providers in rural areas, the Robert C. Byrd Health Sciences Center has developed many programs to support rural providers. And I might add that the money to support these programs by and large comes from the practice plan of the medical school. We are very proud of this.

In 1985, the WVU School of Medicine started a medical access and referral system that goes by the acronym of MARS, and this is a toll-free consultation service that enables university specialists to instantly provide medical information to West Virginia's rural practitioners. And this has been very successful. We now have about 1,500 calls come into our medical school now every month, most of them from rural doctors and dentists in West Virginia. And these rural practitioners tell us that this MARS system is a real lifeline that allows them to provide better patient care in our State.

We have a number of other programs, and they are in my prepared statement and I will not belabor those today. I just want to give you a little bit of background for the record about West Virginia's health-care problems. In the last 5 years, five rural hospitals in West Virginia have closed due to financial problems, and there are several more that are precariously close to that. Rural hospitals are finding it increasingly difficult to retain patients in the local community, and many patients are being transferred to tertiary facilities even outside of West Virginia, because of specialty physicians that are available there to diagnose their problems. And the practitioners in the rural areas just could not get the kind of help that they needed.

We saw this and we knew that we needed a better system to triage patients better and to keep patients as much as possible in the local communities, where this is appropriate, in order to maintain viability of these small rural hospitals. Delivering care locally is not only better for the patient. West Virginia patients do not like to travel. The mother does not like to go to Charleston to see her daughter in the hospital. But it also increases the financial viability of rural hospitals and it is much cheaper to take care of people in small hospitals.

Also, a frequently cited reason for physicians not locating to practice in a rural area such as West Virginia is professional isolation. West Virginia has a number of counties designated as rural manpower shortage areas and programs have been established there to decrease isolation and lay the groundwork for network development. Rural physicians feel very much alone in their practice without any backup or advice. And I know this. I talk to these guys every day on the phone. Some of them are scared to death.

A recent study of rural physicians in Colorado found that more than one-half of all rural physicians were on call at least every other night. Every other night on call. I have not done that since I was an intern, and I think that is against the law in some States now. They average 20 to 30 percent more patient visits than their urban counterparts. They see many more patients than urban physicians, and they also earn 10 to 20 percent less money. We need creative programs like telemedicine to help provide support for these folks out there so that they can stay out there and practice medicine.

Telemedicine, which comes from the Greek tele-distance, is not a new concept. It has been around in various forms since at least 1955, when amateur radio broadcasters began broadcasting continuing medical education lectures. In 1959 a teleradiology program was begun in Montreal, and around the same time some folks in Nebraska started doing telepsychiatry for group therapy. In the late 1960's and early 1970's, links were established between the Massachusetts General Hospital, Logan Airport, and the Bedford VA. And since then, many patients have been served in these types of programs.

Several studies involving literally hundreds of patients indicate that telemedicine can provide accurate diagnosis and increase patient retention in rural areas and be very cost effective. As the group from the Mayo Clinic showed us today, there is a lot that you can do with this. In medicine really seeing the patient and talking to the patient is 90 percent of the diagnosis. That is the way you make diagnoses.

In 1990——

Senator ROCKEFELLER. To the extent that you would think that not only the video connection but physical distance could present a problem, is the case that you could sense a little of the struggle of the one dealing with the other?

Dr. BRICK. Right, right. It depends on the amount of time you can spend with a patient. Warm them up to it, and they relax very much and they become very receptive to this, and very few patients do not enjoy the experience. This distance feeling that you get is, I think, an artifact of the shorter period of time that we had today to spend on the consultations.

Senator ROCKEFELLER. And also something people can adjust to.

Dr. BRICK. Right, they adjust to it. And the doctors adjust to it. The other thing is you have to have experienced practitioners that are the ones that are seeing the patients on the receiving end. This is not something that you would want somebody that is not confident of their clinical skills doing. The person that you want to be receiving these consults needs to be a good doctor, a real doctor.

In 1990, Mountaineer Doctor Television—one more quick comment. We do have other instruments that are available.

Senator ROCKEFELLER. We do not need to have history. I need to have your observations.

Dr. BRICK. Right, OK. The other comment or question about the distance was about our being able to examine people effectively. There are in a number of instances, many instances, very economical little pieces of equipment that we have available now that can be used to examine these patients at a distance. There are elec-

tronic stethoscopes that are available, cameras to look into people's mouths, look in their ears. And there are more things coming along all the time. And so we can do a very good exam, I think, in many instances.

Let me tell you about our system. MDTV utilizes a hub and a spoke concept and we have a multipoint communication system between all the sites. All the different sites can talk to each other and they can talk to us at the hub site. It is on 24 hours a day. We use T–1 phone lines because we felt like that we need to have as good a picture as we could in order to give the doctor and the patient the assurance that they were getting as good an image possible and that they were getting as much information as they could from the system. These T–1 phone lines are over regular copper phone lines. West Virginia has very little fiber optic cable in the areas that we want to go to.

And it is on 24 hours a day with on-line access. It is very doctor proof. You go in and you push one button, and there it is. I mean I cannot even program a VCR, but I can make this thing run. And those kind of systems are necessary in order—to address your previous question about user friendliness—to make people use it on both ends.

We have a hub site in Morgantown and the spoke sites are in Petersburg, Elkins, and New Martinsville. All of these are small, rural hospitals in West Virginia. And we plan, with the renewal of our grant from the Federal Office of Rural Health Policy that we used to put this system in, to set up another hub site in Charleston in the southern part of the State, and three more spoke sites with that money.

The way the system works is the patient's doctor calls over the MARS line, talks to the consultant on the phone. He says "We ought to see this patient on the TV." If they decide the patient needs to be seen now, the patient is seen immediately. The consultation room is in the emergency room of the university hospital. They go over and see the patient. If the patient can be scheduled, then we have video clinics that we schedule the patient into, and these clinics are held just about every day so that there will be scheduled time to see patients.

Medical education is another important part of this program, we think, both postgraduate, continuing medical education, and also undergraduate medical education with our medical students. West Virginia requires now that all our doctors have 50 category I CME credits every year. They can get this over MDTV without leaving their small town. They can see medicine grand rounds, pediatric grand rounds, surgery grand rounds, and participate in a fully interactive way.

We also now require all of our medical students to complete rural rotations in their third and their fourth year. By next year, every WVU medical student is expected to receive over 1 month of rural primary care training to enhance the opportunity for them to choose a rural primary care practice.

Senator ROCKEFELLER. Thanks to the Kellogg Foundation.

Dr. BRICK. Yes, sir. And MDTV, we believe, will play a vital role in linking these students with us back at the medical school. For example, yesterday my brother, who is also involved in this, did a

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consultation down in Petersburg, and two of our medical students were on the other end in the consultation room with one of our doctors down in Petersburg. And they got to see how this system works right up front, and we think that that is very exciting. We can bring them along and show them what we can do for them if they are out there in these small communities, and maybe it will help attract them and they will want to hang out their shingle in a small place in West Virginia.

We also believe that——

Senator ROCKEFELLER. Dr. Brick, you are going to need to wind up, sir, if you can.

Dr. BRICK. One more comment, just a couple of comments. I am almost done. [Laughter.]

We believe that consortiums that we can build with this kind of program are precisely the kind of consortiums that people are talking about with networks around the country, and we believe that this program will allow us to encourage primary care practice in our students. We believe these programs will dovetail very nicely with the Primary Care Work Force Act of 1993, which we support.

Now, I would just like to make two comments, I think, about problems, Senator Rockefeller, with this kind of program. The first thing is cost, and one of the major costs is equipment, but another major cost is the ongoing cost of the phone lines. The phone line costs go up dramatically when you cross a LATA. And in most States, to go from one part of the State to another you are going to cross a LATA.

For example, the cost for us to run a line from Morgantown to Charleston, a T–1 phone line, is $4,500 a month. And we have been told that that is the best price we can get in an open-bid process, as part of this grant. I think that is a lot of money for a phone line. And we have been told that a significant part of that cost is because of the tariffs that are placed on this as a result of crossing the LATA.

We would very much like for some national help with this problem. We think this needs to be addressed on a national level, if not for industry, at least for nonprofit organizations and educational programs. We are not making any money off of this program now at all. We would like to have some help with the cost of the phone lines.

The other thing that I wanted to mention as far as a problem is reimbursement for clinical services. Right now there are a very few States and areas where people have done some very creative things in order to be reimbursed for some of these consults. That is one way to recruit some of the phone line costs, but by and large this is very difficult to obtain.

I just learned that Dr. Todesco who is at the Medical College of Georgia just received approval from the Medicare intermediary there to be able to do telemedicine consultations at additional site, coming back to the Medical College of Georgia, and that Medicare would pay for these. I think this is the only State, the only Medicare intermediary, that has agreed to do that. We need some help with this. I plead with you. I do not know how to fix it, but please give us some help.

A third problem is the problem of standards in transmission. That has already been addressed by the folks here, and I just want to reemphasize what they said.

Thank you very much for the chance to come up and talk to you all, and we are very excited about this program and we are going to make it work. Thank you.

[The prepared statement of Dr. Brick follows:]

PREPARED STATEMENT OF DR. JAMES E. BRICK

INTRODUCTION

The Robert C. Byrd Health Sciences Center of West Virginia University (RCB HSC) is located in Morgantown, WV. The central mission of the RCB HSC is service to the State of West Virginia. West Virginia has an approximate population of 1.8 million with approximately 3,000 physicians, and 63 hospitals (over half of which have less than 100 beds).

Because of its terrain and distance to urban areas, recruitment of primary care physicians to rural West Virginia is a problem. In order to reduce feeling of isolation and to increase retention of providers in rural areas, the RCB HSC has developed many programs to support rural providers. In 1985, the WV(J School of Medicine started the Medical Access and Referral System (MARS). This toll-free consultation service enables university specialists to instantly provide medical information to West Virginia's rural practitioners. MARS now receives over 1,500 calls a month. Rural practitioners that use MARS have indicated that it is a lifeline that allows them to provide better patient care.

MARS and other outreach programs now operate in 53 of West Virginia's 55 counties. Briefly, other programs include:

- the Visiting Clinician program, which provides faculty appointments to rural primary care physicians;
- outreach clinics throughout rural West Virginia;
- Continuing Medical Education outreach lectures;
- Partners in Health, providing support to small rural hospitals;
- the Center for Rural Emergency Medicine (CREM) which has established a rural emergency medicine network for education and service throughout the entire state; and,
- West Virginia Consult, a program of on-line medical information for rural practitioners and hospitals.

BACKGROUND

In the last five years, five rural hospitals have closed in West Virginia due to financial problems. Rural hospitals were finding it increasingly difficult to retain patients in the local community and many patients were being transferred to tertiary facilities because the specialty physicians could not diagnose the patient based on the verbal description provided by the rural physician.

A better system was needed to triage patients to keep patients in the local community where appropriate. Delivering care locally is not only better for the patient, but it also increases the financial viability of rural hospitals.

Also, a frequently cited reason by physicians for not locating a practice in a rural area is the isolation rural physicians feel. West Virginia has a number of counties designated as Health Manpower Shortage Areas and programs have been established to decrease isolation and lay the groundwork for network development. Rural physicians feel alone in their practice, without back up and advice. A recent study of rural physicians in Colorado found that more than half of all rural physicians were on call at least every other night. They average twenty to thirty percent more patient visits than their urban counterparts, yet earn ten to twenty percent less. Creative programs need to be developed to provide support and increase recruitment and retention of these neededrural physicians.

Telemedicine (Gr. tele-distance) is not a new concept, having been around in various forms since at least 1955 when amateur radio operators began broadcasting continuing medical education lectures. In 1959, teleradiology began in Montreal. Around the same time, telepsychiatry group therapy began in Nebraska. In the late 1960's and early 1970's, links were established between the Massachusetts General Hospital, Logan Airport and the Bedford VA. Since then, many patients have been served by these types of programs.

In 1990, Mountaineer Doctor Television (MDTV) began as a pilot project at Wetzel County Hospital in rural New Martinsville, WV. The system links university specialists to rural physicians and their patients allowing two way interactive video and audio communications. This project led to the submission and award for a grant from the Federal Office of Rural Health Policy.

MDTV

The System

The MDTV network utilizes a hub and spoke concept for multipoint communication between all of the sites. The technology utilizes compressed video, and fully dedicated T1 lines for 24-hour a day on-line access. As with all the outreach programs, MDTV emphasizes service and educational goals.

The hub site in Morgantown includes a master control room, an auditorium and a consultation room. spoke site facilities include a consultation area and conference area.

Patient Consultations

Patient consultations via MDTV are initiated by the rural physician calling MARS. If, after conference with the WVU specialist, it is determined that the patient would benefit from an MDTV consult, a decision is made about timing. If the consultation is of an emergent or urgent nature, it is done immediately. If the consultation is of a more routine nature, the patient is scheduled for a video clinic. Video clinics are held several days a week.

At the conclusion of each MDTV patient consultation, the patient, the rural physician and the WVU specialist complete an evaluation form which asks several questions about their satisfaction with the MDTV consultation.

Medical Education

West Virginia requires that physicians obtain a minimum of 50 Category I CME credits every two years. To assist the MDTV spoke site physicians, scheduled Continuing Medical Education lectures are provided weekly. In addition, spoke site physicians can participate with the Morgantown specialists as they review patients referred to Morgantown.

The CME component of MDTV is a tremendous service for the rural practitioners. They are afforded substantial CME opportunities right in their community hospital at times which are convenient, on topics they have chosen, and on a regular basis.

West Virginia University requires all medical students to complete a rural rotation in their third and fourth year. By next year, every WVU medical student is expected to receive over one month of rural primary care training to enhance the opportunity for them to choose a rural primary care practice. MDTV will play a vital role in linking these students with the medical school's main campus. As consortiums of facilities develop to provide more ambulatory opportunities to train residents, MDTV will provide a critical educational link.

The Committees

Two committees have been established to assist in the program implementation. The Advisory Committee, comprised of distinguished physicians and administrators from similar programs across the country, guide the program and ensure achievement of MDTV goals. The User's Committee, comprised of spoke site administrators and physicians, actually discusses issues and additional opportunities for the system. These two Committees are a great asset to MDTV.

The Technology

The centerpiece of compressed video technology is a piece of equipment called a CODEC (Code/DECode). A CODEC a computer that digitizes audio and video signals by a process called compression. In our system, the signals are transmitted over full T1 phone lines. At the receiving site, the signal is converted back to an analog signal by decompression or decoding. This takes approximately one second to accomplish.

Currently, CODECs produce signals that are near broadcast quality in that they are capable of generating 30 frames/second and 480 TV lines of resolution. (By comparison, home video is 230 lines of resolution). The capabilities of the CODECs are brand name and band width dependent, with best results being obtained by some of the proprietary algorhythms (computer decompression and compression programs). Further, the system is integrated with "user-friendly" control systems that eliminate the need for 24-hour, on-site technical assistance. Security is addressed in the MDTV system by virtue of the hub site having sole access and control of the

network's routing and switching capabilities at the multipoint control unit. Neither uplinks nor satellite time are used by MDTV.

BARRIERS

Several barriers exist today that make the development of telemedicine programs like MDTV difficult to implement. Obviously, the capital cost associated with the acquisition of the necessary equipment is very high. However, the transmission costs are equally expensive. As described above, the signals are transmitted over T1 or some fraction of T1 telephone lines. In order to ensure patient confidentiality, these lines must be as secure as possible. In most areas of the country, this means a dedicated phone line. These lines are available 24 hours per day and the bill reflects this level of service.

Another problem that arises when a network such as MDTV is developed is the service areas for long distance providers, known as LATAs. When a phone line crosses a LATA, the rates increase tremendously. For example, in West Virginia, the line charge for the 150 miles between Morgantown and Charleston with a T1 line connecting two different LATAs is $4400 per month including the tariff from C&P Telephone. This is the best price we could get in an open bid process. When plans are made to cast a network to connect rural areas with urban areas for educational and service programs, crossing the LATAs becomes a significant amount of money. Even if we can obtain universal reimbursement for consultations delivered over MDTV, the issue of how much we have to pay for the phone lines as non-profit entities should be addressed. We think that this should be addressed on a national level.

Another of the biggest challenges in the immediate future involves obtaining reimbursement for clinical services provided over MDTV. Around the country, most telemedicine programs have been established linking rural sites to more urban state medical schools. Because there is no universal system for reimbursement for these consultations, these schools have had to resort to creative methods to retain financial viability for the program. In Kansas, some very excited doctors were able to get Blue Cross and Blue Shield to agree to pay for telemedicine consults. I just learned last week that Dr. Todesco at the Medical College of Georgia (MCG) received approval from the Medicare intermediary for Georgia to reimburse telemedicine consultations provided by MCG faculty. For most of us though, these developments are only wishful thinking. We need leadership from Congress to recognize the value of this service and the contribution it can make to healthcare and education in rural America.

THE FUTURE

The network has now been expanded to include not only New Martinsville, but also Elkins and Petersburg. With funding just obtained from the Office of Rural Health Policy, we will develop a second hub site in Charleston, West Virginia at the Charleston Area Medical Center along with adding two spoke sites. As continued funding permits, the long term goals of the MDTV project include expansion to at least 10 other rural sites and the establishment of a third hub site. We can already interface the system with some rather economic diagnostic tools such as electronic stethoscopes, ultrasound recordings of the heart, and macro cameras for intraoral or ear exams. The high quality that this system will transmit is also being evaluated as a way to transmit X-rays in a very cost efficient manner from rural to urban sites.

We believe that in the 1990's, telemedicine programs such as MDTV will allow tertiary care centers to establish true total rural healthcare networks throughout their service areas. This will improve patient care, increase the viability of rural hospitals and medical practices, and provide a critical support system that will increase the recruitment and retention of rural primary care physicians.

Senator ROCKEFELLER. Thank you, Dr. Brick. Thank you very much. I am a great advocate of physician's assistants in West Virginia. We like to think we started it at a place called Alderson Broadus College, but perhaps we did not. And in any event, Mr. Reid, we are very glad that you are here.

STATEMENT OF JIM REID, DIRECTOR, EASTERN MONTANA TELEMEDICINE PROJECT

Mr. REID. Senator Rockefeller, thank you very much. I appreciate that endorsement of my first profession. My second profession seems to be now telemedicine, leastwise in Montana.

I have submitted a full testimony and ask that be entered into the record.

I have been asked here today to tell you about a rural initiative we've undertaken in Montana called the Eastern Montana Telemedicine Project. This project has been under research for about 3 years. It is operated by the Deaconess Medical Center in Billings, MT, which is a 272-bed tertiary care facility—272 beds isn't very big by most folks standards, but it's about the biggest hospital we have in Montana.

The service area of Deaconess is 300 miles in all directions. We service not only eastern Montana but northern Wyoming, as well as the western Dakotas. It is a big chunk of space, and Deaconess is one of only two tertiary care facilities in the region. We do an awful lot of things to assist the primary care providers who are in the rural areas surrounding Billings and the Eastern Montana Telemedicine Project is one of those undertakings.

We are just beginning a six-site, 6-month trial of telemedicine as you have seen it here today. In fact, we are using the very same equipment that you have in this room today in terms of the videoconferencing systems and some of the medical peripheral devices that are here to generate medical imaging for transmission over a network.

Senator ROCKEFELLER. And you could just go ahead and afford all of that?

Mr. REID. I did not say that, sir.

Senator ROCKEFELLER. OK.

Mr. REID. I will be glad to offer clarification on exactly why it is just a 6-month trial, if you want to pursue that further in just a little bit, and I will talk a little bit about the cost effectiveness of this technology.

One of the things it took us a little while to figure out while we were developing this project is that telemedicine applications alone, although the initial initiative for this project, are not going to be those which support this technology, certainly in rural communities over the long run. We have taken a rather broad perspective on the application of two-way interactive videoconferencing technology to telemedicine as well as to other purposes in servicing rural communities. I will describe four applications for you.

The first is pure, plain, telemedicine, or video applications of videoconferencing to provide specialist physician services to rural communities; that is, to rural primary care providers. Billings has many specialist physicians. Rural primary care communities have very few. And the very factors that have been described here by my colleagues about professional isolation, rural physician shortage, overworked and underpaid, all factor into why we believe this technology is going to have a positive impact on rural communities.

The second application of the Eastern Montana Telemedicine Project is to provide mental health consultations. All of eastern Montana is a psychiatric underserved area. There is one psychia-

trist in Montana east of Billings, and she's leaving. The remainder of the healthcare professionals are social workers, licensed professional counselors, all of whom could benefit from a consultation periodically with a psychiatrist or even one of their colleagues in another community about a given patient interaction or a patient case or problem.

We will be able to provide over this network on demand psychiatric consultations to mental health workers in any of the communities. The communities will themselves be able to consult with each other, the mental health facilities in each of the four rural communities on the network, to support each other as colleagues as well as by gaining psychiatric consultations.

It has already been mentioned that continuing medical education delivered through telemedicine networks is a very practical application. I would offer that by giving rural physicians, physician assistants, administrators, pharmacists, EMT's, opportunity to participate in continuing medical education programs currently generated in Billings or in Miles City or any of the sites on the network gives them a tremendous benefit, tremendous access to continuing education, up-to-date information, they just otherwise wouldn't have or for which they would have to travel.

Some of the cost effectiveness of this technology plays into that. We can discuss that at your desire.

Last, and something I haven't heard here yet today which I believe makes our project somewhat unique, is our intent to develop this technology and its community development applications. We, during the 6-month trial, will make the telemedicine or the videoconferencing equipment in each of the five rural sites plus the Billings site available to anyone in the community who wishes to use it. We believe that by building a very broad base of end users within each of these rural communities we will be able to effect a cost-effective solution and a way to finance this technology long term.

If a regional bank president wishes to conduct monthly meetings with his branch office vice presidents in rural communities, currently, they travel. A day to go, a day to go back, and a day, perhaps less, perhaps 2 hours in a meeting. If a farm implement dealer wishes to update a sales person on a new product to be distributed in their community, they have to travel to the home office to get that education.

A perfect example is a conference we conducted 2 weeks ago. If the Eastern Montana AIDS Consortium wants to get together to share the most current information about managing aids patients in these rural communities, they all have to drive to one location and meet. They did that last week over our network. It saved them hours and hours of time and travel. They were able to conduct an hour-and-a-half meeting, convey all the information they needed, and they all went back to their other jobs and responsibilities without wasting lots of time on the highway.

Therefore, we have four applications: Physician consultation, mental health consultation, continuing medical as well as higher education opportunities, and community development. We are going to be conducting the same sorts of telemedicine applications

as you have seen—telemicroscopy, teleradiology, any medical image can be transmitted over this network.

You can literally have a family physician conducting a gastroscopy in a rural area with a gastroenterologist at the urban site consulting, saying real time, while the procedure is being performed, "Oh, wait a minute. Back up. Let us take a look at this. Let us get a piece of that. That needs to be biopsied."

We think that not only the enhanced patient care that this kind of technology will provide, but also the continuing medical education, the direct immediately applicable benefit to rural primary care provider's practices, is almost immeasurable.

Dr. Brick mentioned electronic stethoscopes. They are another input device that can be used so that we can literally listen to heart sounds and lung sounds of a patient hundreds of miles away with enough clarity to be representative of what the physician or the other provider would hear if they were in person.

The network we are using right now in eastern Montana is a dedicated DS–1 or T–1 network. It is created in a daisy chain fashion to be as cost effective as possible. It is also a rather robust network, to use an industry term. Not only are we conducting videoconferencing over this network but we have the capability to link our hospital mainframe with other rural hospital mainframes for purposes of information sharing, for purposes of inventory management, and we have the ability to provide voice services to the same facilities, as well. We have at least three different kinds of data that we are transmitting over this network.

The network has multipoint capability so that any site on the network can talk to any other site or so that all sites can convene and participate in a conference jointly. We conduct numerous continuing medical education conferences at our medical center, and now we can disseminate those conferences to five communities and their providers instead of one without the travel that is involved for the rural providers.

I should say that the end users of this network are 4 communities which provide service to approximately 11 counties. That equates to 36,458 square miles. Yet the population of that service area is only 72,163, which converts to a population density of 1.97 people per square mile. We're not talking rural here, we're talking frontier. The Federal designation of frontier is less than 5 people per square mile.

I should mention that the communities that we are serving with this six-site trial represent four levels of care. Not only do we have a tertiary care facility in Billings, we have two secondary care hospitals. One has 99 beds, one has 49. We have a primary care facility of 46 beds, and we also have a facility called a medical assistance facility, which is not even a hospital. It is staffed by a physician and physician assistant team. It is a limited in-patient stay rural primary care minihospital.

The MAF model in Montana has been that after which the Federal program was modeled. We are very proud to have five MAF's in Montana. We believe telemedicine access will significantly support services provided in these small, scaled-down, rural hospitals.

Potential impact, those things which we plan to show over the 6-month trial, include the broader scope of services that can be pro-

vided in rural communities by telemedicine consultation. We think that making more services with specialist consultation available to rural primary care providers is going to give them a greater sense of value to their community. We hope that that will contribute to their retention in those communities and decrease the problems with recruitment and retention that rural communities currently have with primary care providers.

We think that the enhanced level of communication between urban and rural physicians is going to provide for decreased professional isolation, as it has been described. We think that decreasing the travel time and expense involved in getting continuing medical education will allow primary care providers to pick and choose, not feel pressed to get CME purely to gain the credits that they are required to gain.

It is very important to note that, again, using some preliminary numbers, there appears to be substantial benefit to retaining patients in rural communities. An early telemedicine project that's just finished some of their studies in Texas showed that retrospectively about 50 percent of the patients that were transferred from a rural primary care facility to a large urban center could have been retained in that rural hospital if the appropriate telemedicine consultants were available. That can make the difference between financial life and death for a small rural hospital.

Of course, you know that when a patient is transferred from a rural hospital to an urban center, they don't just take their healthcare dollars. They also take their durable goods dollars, their pharmaceutical dollars, et cetera. All of those dollars, rural communities really need to retain there.

One of the things that, to my knowledge, is not in the least bit calculated into the costs of the national healthcare budget are those costs incurred by patients that are not reimbursable or billable costs. And I speak specifically to the money that they spend traveling to gain healthcare services.

When a patient drives 300 miles from Culbertson to Billings for a 20-minute office visit by their cardiologist, which is the nearest cardiologist, they do not get reimbursed at 28 cents a mile by anyone for that mileage and they also don't get reimbursed the time that they lose in traveling: 2 days—1 day coming and 1 day going—off work, plus 300 miles each way, plus hotel and meal expenses.

Senator ROCKEFELLER. You are talking about the patient?

Mr. REID. The patients.

Senator ROCKEFELLER. Do you think the patients should be reimbursed for that?

Mr. REID. No, not at all. What I am saying is that those are figures that are not calculated into the healthcare expenditure and which we have no quantitative measure of, but which this technology could significantly impact in terms of savings. It is going to make it very difficult to quantitate that if it is not being measured anywhere, but we are going to try and do that during our trial.

We believe that the community development applications will provide broader economic markets, larger service areas for those businesses, for rural social and community groups in rural communities, and that is going to have significant impact, as well.

I will just mention briefly my comments on the barriers to the rapid implementation of this technology. The issue of cost has already been discussed. This is not readily available, extremely inexpensive technology. The system that you see here still runs between $50,000 and $60,000. That is a significant capital output for a rural hospital.

The Rural Electrification Administration and the Rural Health Transition Grant Program both do provide money for this kind of equipment to rural hospitals. I would simply encourage you to continue to consider funding those programs because that is one way in which rural facilities can afford this equipment.

I would also note that because of the community development applications, if a local business were willing to pay $100 an hour to use this network as opposed to driving 6 hours, attending a 20-minute or a 2-hour meeting, and driving an additional 6 hours, I think $100 an hour is not unreasonable. Anyone in eastern Montana that I know would do that.

A hospital that has this system would only have to make that system available for 12 hours/month or conduct 12 1-hour business sessions to pay their ongoing network costs to support this equipment. That's a relatively cost-effective solution. If they can simply make this available 12 times a month for a business person to come in and do a 1-hour conference on our existing network, they've paid their network charges for the month.

Reimbursement is a biggie. There are two or three Federal programs right now that are encouraging the development—

Senator ROCKEFELLER. Mr. Reid, I am going to have to ask you to wind up.

Mr. REID. This is my last point—that are encouraging the deployment of this technology and at the same time the Health Care Financing Administration is not reimbursing physician services for it. Montana is unique in our telemedicine program in that we do not have a medical center, an academic medical center, we do not have a residency program currently, we do not have a medical school, we do not have physicians on faculty to provide these consultations. We are operating in a nonprofit environment but physicians need to get paid if they are going to conduct telemedicine consultations instead of bringing the patient to the doctor or the doctor to the patient.

I realize sitting here now and asking Congress to mandate Medicare coverage for yet another medical service is kind of like sitting in downtown St. Louis and praying for rain. But let me say that if in all its infinite wisdom the Federal Government wishes to promulgate policies that will stimulate the dissemination of this technology, reimbursement is an issue that is going to have to be addressed.

Senator ROCKEFELLER. What you are saying in effect is that telemedicine intervention between a doctor and a patient is not counted as a patient visit to a physician.

Mr. REID. That is correct. I would say right now that the Health Care Financing Administration does pay—or Medicare—does pay for teleradiology consultations, as we saw. A radiologist can interpret an x-ray. They do pay for the electronic transmission of EKG's and fetal monitoring strips. But with the one exception that on an

intermediary level has been undertaken in Georgia, and there is no Medicare payment for a physician seeing a patient, as you just saw today, over this technology.

Senator ROCKEFELLER. That is interesting.

Mr. REID. It is not considered a service.

Senator ROCKEFELLER. It is interesting nobody made that point until your very last one. I am glad that you made it.

Mr. REID. I am glad that you allowed me to speak. Thank you very much.

[The prepared statement of Mr. Reid follows:]

PREPARED STATEMENT OF JIM REID

Mr. Chairman, and members of the Committee, I am Jim Reid, Physician Assistant, and director of the Eastern Montana Telemedicine Project. I have been asked to describe our project, briefly describe the technology we are using, discuss the potential impact this technology can have on rural healthcare systems, and lastly point out a few barriers to full implementation of this technology.

The Eastern Montana Telemedicine Project was developed by Deaconess Medical Center in Billings, Montana. Deaconess is a 272 bed tertiary care medical center with a three hundred mile radius service area that includes eastern Montana, northern Wyoming, and the western Dakotas. As a regional referral center, Deaconess recognizes the problems associated with the delivery of rural medical care and operates many programs designed to support rural primary care providers.

The Eastern Montana Telemedicine Project has just begun a six site, six month trial intended to demonstrate and measure the impact of two-way interactive videoconferencing on four rural eastern Montana communities. The project has four major components:

1) delivering specialist physician services by videoconference;

2) delivering mental health consultative services;

3) offering continuing medical and higher education programming to rural communities;

4) and lastly to explore community development opportunities made possible by videoconferencing between geographically isolated rural communities.

The Eastern Montana Telemedicine Project will explore several telemedicine applications, including the provision of patient care services during scheduled specialist telemedicine clinics, the provision of consultations upon request by rural primary care or mental health professionals, and the use telemedicine technology to transmit emergent x-rays, microscopic slides, endoscopy video, echocardiograms, an-heart and lung sounds. During the trial project, physicians and mental health professionals in each of the sites will regularly interact with specialists and each other, sharing the most current information and advice needed to address the needs of their patients.

In addition to continuing medical education for physicians and other healthcare providers, health, wellness and higher education courses will be provided for rural residents using the same telemedicine systems and network.

Telemedicine facilities will also be made available to the communities at large allowing videoconferences between businesses, community service, and social organizations. Having the ability to group conference with business associates, sales and service personnel, and even social contacts in distant communities, will bridge the communication gaps imposed by geographic barriers.

The videoconferencing equipment used is PC platform based CCITT standards compliant. Because the equipment complies with international standards, it is compatible with other telemedicine projects across the nation. Montana has neither a medical school nor residency program, therefore there is great potential to benefit from links with the telemedicine program at the Mayo Clinic, for example.

The telecommunications network for this project will consist of dedicated DSI facilities leased from the regional Bell operating company. Multi-point conferencing capability is configured into the network to allow any point on the network to conference with any other, or all points to conference together simultaneously.

The end users of the Eastern Montana Telemedicine Project are the rural communities of Culbertson, Glendive, Miles City and Sidney. These four communities provide medical and mental health services to eleven surrounding counties. Many of these counties are not even considered rural, but instead "frontier." The Project service area encompasses 36,458 square miles, has a population of 72,163, and a resulting population density of 1.97 persons per square mile.

The facilities participating represent at least four levels of care. Culbertson does not have a hospital but instead a Medical Assistance Facility, or MAF, staffed by a physician/physician assistant team. Glendive Medical Center is a primary care facility. Sidney and Miles City have secondary medical care facilities providing limited specialist physician services, and Deaconess is a tertiary care facility.

Telemedicine hold enormous potential for rural communities. Potential benefits include:

Enhanced ability to serve the healthcare needs of surrounding rural communities by providing telemedicine consults to, or receiving them from other participating sites.

Specialist physician consults via telemedicine, will enhance the scope of services delivered by the rural provider. Delivering a higher level of care will give the rural provider an elevated sense of value to the community.

Enhancing the level of communication and exchange of information between isolated rural physicians and their urban colleagues will decrease the rural physicians' perception of professional isolation and perhaps even lessen their load.

Providing increased access to locally available continuing medical education offerings will decrease rural providers' requirements to leave their practices and decrease the financial burden of gaining mandatory continuing education credits.

Expanding the scope of services available at the local level with telemedicine consults, will result in retention of patients, and their healthcare dollars in the rural community. This will improve the economic viability of small rural hospitals.

Telemedicine services can result in decreased costs and the loss of productivity associated with administrative and educational travel. it will decrease what we in eastern Montana call "windshield time" or what the Texas Telemedicine Program refers to as "salary spilled on the highway."

By the same token, telemedicine may result in decreased overall costs to rural residents for accessing healthcare services by demonstrating savings in patient's time and travel expenses. These expenses, by the way, are not even considered in the national healthcare expenditure figures.

The potential results of the non-medical applications include improved educational opportunities, enhanced communication between business associates, and larger service areas and broader economic markets for rural community residents.

There are several issues which I believe are distinct barriers to the implementation of telemedicine in all rural communities across the country.

The cost of videoconferencing equipment continues to drop, however it is still cost-prohibitive for the smallest rural facilities. Federal grant programs like the REA's Distance Learning and Medical Link Program, and the Rural Hospital Transition Grant Program continue to be the best chances for these facilities to acquire this equipment. I encourage you to consider continued funding for these and similar programs.

The nation's telecommunications infrastructure needs continued improvement and telecommunications network costs need to be more affordable. We are acutely aware of this problem in Montana. I believe senator Burns and several other members of Congress understand this need and are working to address it. I encourage your support of their initiatives.

Lastly, and I believe most importantly, the issue of reimbursement for telemedicine services must be addressed. The Health Care Financing Administration does not reimburse for direct patient care services provided by telemedicine to Medicare recipients. Most third party insurers are following HCFA's lead. It is safe to say that we will never convince physicians to provide consultative services over a technology that will decrease the number of patients that come to see them in their offices, if they cannot be reimbursed for the consultation. I believe the overall cost of providing healthcare services will ultimately decrease if this technology is implemented on a national scale. But first we must provide the motivation for that implementation. I would lastly ask you therefore, to consider legislation mandating Medicare coverage for telemedicine services.

Mr. Chairman, members of the committee, thank you very much for this opportunity to share these thoughts on telemedicine technology. I would gladly respond to any questions you might have.

Senator ROCKEFELLER. Dr. Brick.

Dr. BRICK. There is one State where private insurance companies have approved this, and that is Kansas. But to my knowledge, that is the only one. And the only State that allows this with Medicare that I know of is Georgia.

Mr. REID. It is, of course, Medicare that tends to set the stage for the private insurance companies. I am very pleased to say that Medicaid in the State of Montana has elected to allow us to bill for and anticipate reimbursement for these services.

I would point out that Medicaid in Montana pays travel. If a patient has to drive 300 miles to get a consultation it will pay that patient's sister, mother, brother, uncle, the mileage to take them to the specialist physician to get that consult. So, it makes good sense to them that if these services can be delivered in the local community they will not be incurring mileage expenses, and that could be a cost savings for the system.

Senator ROCKEFELLER. Senator Burns.

Senator BURNS. I just want to thank Jim Reid and Dr. Flaherty for coming here. I have to bounce out of there and make a 1 o'clock speech. And I appreciate it. I can visit with these two guys just about any time. I appreciate your coming and your being a part of this hearing because I think this is something that Washington needed to hear, No. 1. No. 2, I think it will give us some kind of guideline.

Senator Rockefeller has been very, very open about these new technologies, emerging technologies, and how it applies to our neighborhoods. I think you bring a great story. It also gives us policymakers a way of setting some policy to accelerate. We know this is—and we also know that telecommunications is going to be the cornerstone of any rural development, whether it be in medicine or education or even commerce. It is going to be just like highways and airports were at one time.

So, I appreciate that and I am sorry, I just have to apologize and I do not get to ask as many questions as I would like to, but time got hold of us today as it always does, and I thank you for coming. I really appreciate this and the whole State of Montana does, too.

Thank you, Mr. Chairman.

Senator ROCKEFELLER. What about the West Virginian? Are you glad he came?

Senator BURNS. Well, yes, but he is the only guy that we had up here who knew how to pronounce Kansas. [Laughter.]

And I really appreciate Dr. Brick. I really do. I have a daughter who is just starting medical school this fall, so keep a slot open, if you would.

Dr. BRICK. It is still a good trade.

Senator BURNS. That's right. It sure is still a good trade. Thank you very much. Thank you all.

Senator ROCKEFELLER. Thank you, Conrad, very, very much, for doing this whole thing.

Let me just suggest something in lieu of questions. The whole business of modern medicine and even more modern medicine such as we saw today and the question of basic health services in rural parts of our country really is a staggering one. I am sending two of my healthcare people down into southern West Virginia, Dr. Brick, next week. I have made a series of trips down there and gotten together with physicians and other healthcare providers to discuss what is it in the world that managed competition for Logan, Lincoln, McDowell, Mercer County, et cetera, and the same type of counties exist in Montana.

The answer, of course, is not that one hears managed competition or healthcare alliances and accountable health plans and one throws ones hands up that this cannot work. One simply figures out how it can, because we have to and because we know that people are not getting the services that they need to today. The reason I intervened in your testimony, Dr. Brick, and mentioned the Kellogg Foundation, was that I was Governor of West Virginia for 8 years, and I never was able to solve the question of how do you get three medical schools to get into rural areas and rural health clinics because they wouldn't do it, nor talk to each other, particularly.

It took the Kellogg Foundation with a very simple $6 million matched by the State legislature to say that if you want the $6 million, you three medical schools get together and you get your teaching faculty and your students out into rural health clinics and rural parts of West Virginia and you will get the money. If you do not, you will not. And we were sufficiently embarrassed and inspired as a State that we did it.

But it is fascinating that is no less so in the inner cities. When you say rural areas, inner cities are just as tough. The distances are not as great, but the problems are. It is just that we have to figure out how to make it work.

We have the fortune now of this enormous national dialog going on. It is going to dominate the news, it is going to dominate the thoughts of all of us who care about healthcare and a lot of people who do not for the next 6, 8, 10 months, whatever it takes. And it is our opportunity to make sure, really, that for the first time that the Montanas and the West Virginias and the rural areas in those States get full service—and it sounds to me like Montana has more rural areas, or at least fewer medical centers than West Virginia does. We think of ourselves as rural, but I suspect that you are rural plus. As you say, frontier, 5 and below per square mile.

I think this is an enormous opportunity for all of us. It is enormous responsibility. The knowledge about healthcare in Congress is not great. That is understandable. It is a complex subject. It has been an elite subject, really. And the interaction between policymakers, particularly politicians and people in the medical profession and provider community, has not been a very happy one. The sort of sense of communication and respect has not been very good, but it is going to have to be. It is going to have to work, not just as we do national health reform but much more importantly as we implement it. And that is going to take 10 years to do.

So, I feel personally very encouraged by all three of you, by the way that you talked about your problems, the intensity. Mr. Reid, you were just great. I could not have cut you off if I had thrown a brick at you, you were so into what you were saying, and I like that. I really like that. I mean, I think that is what it takes, that kind of absolute flat out commitment to taking insoluble problems and solve them. We can do that. We have got wonderful people on our State, both of our States, and we can do it.

You have contributed enormously, and you have reminded us most importantly that not everything will stay prohibitively expensive. If it is $45,000 that may be impossible now and it may be unavoidably possible 6 years from now because it will be $18,000,

going to Senator Burns' point that as things get used and accepted they grow cheaper, but everything starts out expensive.

In any event, we cannot afford to fail in our national health reform, and it is just a comfort to know that healthcare professionals like yourself take everything as serious as you do. So, thank God for you.

This hearing is adjourned.

[Whereupon, at 1:25 p.m., the hearing was adjourned.]

APPENDIX

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY DR. LINDBERG

Question. Telemedicine is used to describe a fairly broad range of healthcare applications of computer and communications technologies. How would you define "telemedicine" and what healthcare technologies (e.g., broad-band networking and 3-D computer imagery) would you place under that definition?

Answer. Telemedicine, as defined by the National Library of Medicine in its formal indexing thesaurus, is the "Delivery of health services via remote telecommunications. This includes interactive consultative and diagnostic services." The focus of current research and development is very high speed digital communications and the healthcare technologies which simply cannot be accomplished without advanced high speed networks and computers. However, even everyday communications technologies such as voice grade phone lines and facsimile machines can extend the reach of healthcare institutions and spare both providers and patients the burden of unnecessary travel.

Question. What are the most promising telemedical applications in the diagnosis and treatment of patients, and the data management of healthcare information? What is the state of the art in diagnostic telemedicine, particularly regarding interactive capabilities? In hospitals equipped to practice telemedicine, what are the more conventional uses of telemedicine?

Answer. Though experiments and pilots projects have been conducted in telemedicine for over 30 years, there are only a few uses of communications for telemedicine that would be considered "conventional." Among these would be the use of cardiac telemetry by emergency response teams, automated interpretation of electrocardiograms transmitted by phone lines, and of course the untold billions of phone calls and facsimile messages that underpin the communication-intensive enterprise that is modern medicine. Because medical images may compose millions of bits of information in digital form, it is only recently that sufficiently high bandwidth wide area communications have become available to test the utility of medical image communications systems.

Thus, many of the current state of the art experiments include transmission of Computed Tomography, Magnetic Resonance, and digitized x-ray images (teleradiology), as well as photomicrographs for tissue diagnosis (telepathology). Smooth digital motion pictures are now becoming feasible as well, and systems being developed will test two-way "workstation video" for interactions between providers for obtaining specialty consultation, and interactions between patients and their healthcare providers. Some current studies indicate that rather than being alienated by video technology, patients appreciate being able to see and hear their doctor, and to be seen and heard by their doctor while in the comfort of their homes.

Question. What types of diagnoses lend themselves most easily to telemedicine and what factors determine whether telemedicine is appropriate in a particular case or type of treatment? For example, I understand that telemedicine is particularly effective in administering physical therapy to those with disabilities.

Answer. In the area of medical diagnosis, digital communications can serve as an intermediary for virtually any information which can be converted to an electronic signal: voice, motion video, alphanumeric laboratory data, and signals from sensors such as electrocardiograms and diagnostic imaging machines. Telepathology and teleradiology are being widely tested. On the therapeutic side of medicine, telemedicine systems allow physicians to observe and discuss symptoms with patients who are far away; for example, a recent study in Parkinson's disease showed that doctors observing the movement disorders of patients via interactive video were able to make adjustments to medication dosage with the same accuracy as physicians who evaluated the patients in person.

Question. How is telemedicine used to examine skin lesions and other health problems and ailments? How effective is telemedicine in recording patients' breathing and heart beat, viewing internal orifices, and obtaining brainwave information?

Much of the key diagnostic information used by healthcare providers to make medical decisions is either acquired as an electronic signal or can be converted to one, such as by using high resolution video cameras to transmit pictures of skin lesions. Telemetry of the body's natural electrical activity, such as electrocardiograms and electroencephalograms, has been in use for over a decade using standard phone lines. Until recently, the principal limitation was that long distance analog telecommunications simply did not provide enough capacity ("bandwidth") at a reasonable cost to be able to send objects as large and complex as clinical images outside of the institution where they were created. Economical high speed computers and fiber optic digital communications technology advances have paved the way for a variety of medical services which can be provided in a distance-independent fashion.

Question. Telemedicine can provide dramatic breakthroughs in the collection and retrieval of medical records and related administrative data. It is estimated that U.S. healthcare costs could be trimmed $36 billion by the applications of computer technologies to such areas as: (a) the management and transfer of patient information, (b) the electronic submission and processing of healthcare claims, (c) electronic invent9ry of hospital supplies, and (d) video conferencing for professional training and remote consultations. How can telemedicine reduce costs in each of these areas?

Answer. Any data or information represented in electronic form within a medical center is amenable to the use of telemedicine technologies to communicate it between centers, between provider organizations and third party payers, and indeed to potentially any site where it is needed. The fundamental technologies already exist; what is needed additionally are widely accepted and implemented standards for representing and communicating medical and billing information, and economical "end-to-end digital" telecommunications services that are available in practitioners offices as ubiquitously as analog phone lines are today. With these pieces in place, the $36 billion of predicted savings could possibly be realized.

Question. To what extent is the healthcare community taking advantage of telemedicine to provide more cost-effective data collection, transfer, and retrieval?

Answer. Access to the accumulated scientific knowledge of medicine as represented in databases such as MEDLINE is enjoying rapid growth and widespread popularity: over 50,000 copies of a telecommunications program called "Grateful Med," developed by NLM have been sold, and over 5 million online searches of the NLM's biomedical databases were performed last year. However, patient-specific data such as that accumulated in hospital laboratory computer systems and medical records transcriptions has largely been confined within single institutions, not communicated electronically among organizations. Telemedicine as described in the examples noted above is still rare enough that it warrants publication in the scientific literature as an interesting novelty; it is far from being a standard of care in this country.

Question. What are some of the reasons why telemedicine has not enjoyed wider utilization in healthcare and data management? When an individual hospital wants to develop telemedical capabilities, what are the main problems that it faces in doing that, particularly in terms of costs, technology, and administrative and regulatory barriers?

Answer. Clinical information systems have been "islands of automation" joined as of paper printouts assembled into patient charts. Some of the reasons for the disconnected nature of current practice are the legal requirement for a paper record, the lack of standards for information exchange, concern for privacy and confidentiality of computerized records, and the lack of regulatory or financial incentives to migrate toward a fully electronic system.

Institutions interested in creating telemedicine systems that integrate data from many different computer systems, and provide "exotic" services such as two way interactive video, face systems development costs in the millions of dollars. The proprietary nature of most hospital information systems, the lack of standards for representation an-exchange of medical data, and the high cost of dedicated point-to-point digital telecommunications lines are key impediments. Also, for systems involving licensed health professionals from different states, differing state licensure and accreditation requirements are an additional complication. We are in a situation fully analogous to the privately owned local and regional railroads of the 19th century, all built on different gauge track, without a national vision of fully interconnected systems.

Question. What steps can the federal government, the state governments, and the private healthcare industry take to lower some of the barriers to wider incorporation of telemedicine in the U.S. healthcare system?

Answer. The key activities of the government should be to:

1. Support research, development and deployment of telemedicine demonstration projects to measure and document the effect of telemedicine on healthcare services and costs.

2. Foster and support development of useful and acceptable standards f6r the communication of clinical and billing information in electronic form, and then promote or require use of those standards.

3. Simplify the administrative reporting requirements surrounding healthcare reimbursement.

4. Encourage high speed digital communications technology development by federal investment in advanced telecommunications R&D (including the necessary privacy and security technologies), and by reducing regulatory barriers to technology development and deployment in the private sector.

Question. What is the federal government currently doing to support the development and implementation of telemedicine in the U.S.? What portion of the billion dollar High Performance Computing and Communications Initiative is devoted to telemedical research? To promote the development of telemedicine, which technologies should receive the most federal support?

Answer. To my knowledge, there has not been a comprehensive or recent survey of federal agencies to determine their support for telemedicine projects; anecdotal telemedicine activities have been described by Department of Health and Human Services agencies including the Health Resources and Services Administration (HRSA), the Health Care Financing Administration (HCFA), the National Institutes of Health (NIH), the Indian Health Service (IHS) and the Office of the Assistant Secretary for Health (OASH). Other agencies and components of the federal government such as the Department of Defense, Department of Energy, Department of Commerce, and the Rural Electrification Administration all have supported projects related to telemedicine. No doubt other agencies have also supported relevant work at one time or another.

The High Performance Computing and Communications (HPCC) program began in 1991 with a focus on "Grand Challenges" of science—that is, scientific problems that are in theory amenable to computational or communications-based solutions, but which are currently intractable due to complexity or size. The current administration expressed its intent earlier this year to expand the HPCC program to include "National Challenges" and one of these challenges is improving healthcare through the development and use of "Collaborative technologies to allow healthcare providers in distant locations to provide real time treatment of patients," i.e., Telemedicine. The proposed FY93 funding supplement for this work did not receive Congressional approval; an FY94 HPCC appropriation for this activity is under consideration as part of the FY94 NIH budget. So telemedicine will become a part of the HPCC program if it is the will of the Congress that it be so.

Question. Several of the telemedical systems in the U.S. were started with the help of federal grants. However, others seemed to have evolved naturally in response to marketplace demands on the local healthcare community. Do we need federal grant programs to support funding for telemedical facilities or should the government concentrate mainly on supporting telemedical R&D?

Answer. Support for research and development, and support for demonstration projects that actually implement and evaluate advanced telemedicine technologies are both needed.

Question. How does the quality of telemedically delivered healthcare compare with that of "hands-on" medical treatment?

Answer. Telemedicine seems well suited to serve as an alternative for some, but not all forms of medical care. For example, recent studies in the management of Parkinson's disease patients (reference: Movement Disorders 1993 Jul; 8(3):380-2) and diagnosis of pediatric heart diseases by long distance transmission of echocardiograph signals (reference: Journal of Pediatrics 1993 June; 122(6):S84-8) show that telemedicine techniques are essentially equivalent in accuracy and efficacy compared with traditional "hands on" medical practice. But the technology is not a panacea. For example, a recent Johns Hopkins study of the diagnosis of subtle orthopedic fractures showed that the images sent via a teleradiology system were not as accurate for diagnosis as plain x-rays (reference: Radiology 1993 Jun; 187(3):811-5).

Supporting research and development to define the best role for telemedicine technologies, and to evaluate their effect on patient outcomes, is thus an important component of federally sponsored programs.

Question. Telemedicine often involves video-conferencing, which may not provide the same degree of privacy and confidentiality as a doctor's office.How do you address the problems of maintaining privacy and confidentiality?

Answer. The need for techniques for secure and confidential electronic communications is obviously not confined to medical care. Much of the technology created for the defense and intelligence communities, and financial systems, can and will need to be incorporated into any telemedicine systems that are widely deployed. User authentication, data encryption, and other "trusted systems" technologies are important components of the High Performance Computing and Communications initiative that will be incorporated into future medical systems.

Question. Many physicians will not provide healthcare on a remote basis because insurance companies will not pay for those services. Why won't some insurers pay for telemedical services? Are their concerns legitimate? How can the healthcare community address the insurers' unease with telemedicine?

Answer. Most health insurance companies do not reimburse for care provided as part of a clinical research experiment, such as the testing of a new drug or device. Telemedicine is as much a new form of medical care as organ transplants were three decades ago. But new and effective technologies can be quickly adopted, as shown by the rapid acceptance of and subsequent health insurance reimbursement for Computed Tomography and Magnetic Resonance Imaging. Once the efficacy, safety, and cost-effectiveness of telemedicine-based healthcare services is demonstrated, third party payer reimbursement should follow. In fact, for some services, telemedicine techniques may become the lower cost and preferred form of care.

Question. It appears that most of the activities demonstrated here today are designed for use within a relatively local area. A concern arises over access to such services by low and moderate income residents in remote areas. Has work been done to look at the impact of providing such applications over long distances?

Answer. Though there is no technical reason why digital communications for healthcare cannot be transmitted over thousands of miles, the cost of high bandwidth digital telecommunications services in sparsely populated remote areas remains a formidable barrier, whether those services are provided by wire, fiber optic cable, or orbiting satellite. For this reason, a specific emphasis on rural healthcare telemedicine projects is part of the HPCC biomedical applications program.

Question. What are the cost implications for providing such services? Who is the expected audience and can the majority of Americans pay for such services? Would the involvement of larger firms in the development, marketing, and provision of such services have an impact on costs?

Answer. If healthcare were the sole reason for upgrading the capacity of the country's digital telecommunications infrastructure, it would be a high cost indeed to the average American. However, communications lines that can provide telemedicine services between hospitals, clinics, and patients' homes can be the same communications lines that serve a wide range of entertainment, financial, and educational purposes. Policies that promote competition among telecommunications service providers, as well as competition among health service providers, will help to make telemedicine services affordable.

Question. How does the deployment of such services interrelate to the use of transmission facilities? Will these applications require broadband distribution or will copper cable provide adequate quality for transmission? If the deployment of broadband transmission assists in the deployment of these applications how can Congress assist?

Answer. Some telemedicine applications (such as remote EKGs and limited resolution digital x-ray imaging) can be effectively transmitted via existing copper cable, using both analog voice-grade phone lines and end- to-end digital methods such as narrowband ISDN. Other applications, such as full motion interactive two-way digital video require broadband methods. Congressional action that accelerates the development and deployment of high speed digital telecommunications availability to all of the nation's citizens will enable and promote the progress of advanced telemedicine services.

Question. What impact has the recent lifting of information services restrictions on the Bell operating companies had on the development and deployment of such advanced health services?

Answer. Several of the RBOCs are currently participating in cost-shared regional telemedicine demonstration projects, and others are planning such projects.

Question. Current telephone industry technology permits remote consultation and diagnosis and real-time transfer of health information including x-rays and test results. But certain telephone companies are prohibited from transferring information across Local Access and Transport Area (LATA) boundaries created by the 1984 AT&T divestiture. Whether or not you think the Regional Bell Operating Companies (RBOCs) should be free to compete with AT&T and the rest of them in the long distance business, what do you think about permitting them to cross LATA boundaries for healthcare purposes, particularly in rural areas?

Answer. Human disease and healthcare needs do not respect regulatory boundaries. Legislation and legal impediments that restrict technology development and deployment delay the effective use of telemedicine to improve our nation's health.

Question. A recent study by A. D. Little found that American healthcare costs could be reduced by more than $9.7 billion annually through the enhanced use of "interLATA" long distance services. In other words, more than a quarter of the $36 billion annual cost reductions identified in a 1992 A. D. Little study involved the use of healthcare applications that reach outside of a single LATA boundary. It seems to me that if the prohibition on the RBOCs were removed, they could help bring quality healthcare to people all over the U.S., and particularly in rural areas, and help us all cut healthcare costs. Would you have a problem supporting RBOC participation in home healthcare, claims and materials management, video conferencing and diagnosis within the boundaries of a LATA?

Answer. I would support such innovations enthusiastically.

Question. What about across a LATA boundary?

Answer. From the perspective of fostering effective and economical telemedicine services, LATA boundaries are a man-made obstacle in the fight against a natural adversary which is human illness and suffering.

Question. If you do have a problem with RBOCs going across LATAs, would you describe and explain it?

Answer. I have no problem with this. Unfettered competition to develop new and effective telemedicine services would help all of us.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY MR. REID

Question. What is the probability that the participating sites will be able to afford this technology after the trial is done?

Answer. Although the cost of this technology has decreased substantially, it is still cost prohibitive for the smallest rural medical facility. If, during the six-month trial, substantial cost-effectiveness data can be collected which would predict cost savings to the rural community, even the smallest rural facility may be able to offset capital expenditures based upon either cost savings or projections of revenue retained in the community. However, without such data, the likelihood that smallest rural facilities participating in this project could afford this technology is very small.

Question. Are dedicated phone lines the most cost-effective network for telemedical technology?

Answer. Unquestionably not. Unfortunately, the telecommunications infrastructure in Montana currently does not support dial-up digital service or fractional T-1, or band-with on demand. A dedicated DS1 network was the only way to implement this technology in Eastern Montana today. Every effort should be made to update telecommunications infrastructure in Montana to ultimately allow ISDN or band-with on demand services.

Question. Do you have any estimates of how much money might actually be retained in a rural community with telemedicine?

Answer. We have made some conservative projections. If 25 percent of the patients currently referred to a Billings hospital annually from Miles City were retained as inpatients in Holy Rosary Hospital in Custer County, approximately $70,000 in inpatient revenues would be retained in the community. An additional estimated $67,000 would not be expended based upon mileage, costs and lost wages for an estimated 10 percent of outpatient visits currently being conducted from patients in Custer County in Billings. That is to say that if 10 percent of the current of patient visits from Custer County, conducted in Billings annually, were retained in Custer County, an additional $67,000 could be saved. These represent healthcare expenditures currently not reimbursed, but which ultimately are expenditures to the patient to gain special services outside Custer County. Similar projections for Glendive in Dawson County have been made. If inpatient revenues were retained based upon an estimated 25 percent of patients being retained in the Glendive Medical Center versus transfer to a Billings hospital, approximately $54,000 in inpatient revenues would be retained at Glendive Medical Center.

Additionally, $42,000 in mileage and wages could be saved if 10 percent of the outpatients currently seen in Billings were retained in Dawson County, based upon telemedicine consultative services. For Sidney in Richland County, approximately $40,000 in inpatient revenues could potentially be retained if 25 percent of the patients who are currently transferred to Billings were able to remain as inpatients in Community Memorial Hospital in Sidney, and approximately $45,000 in total expenses saved would be realized if 10 percent of the current outpatients from Richland County were treated in Sidney instead of traveling to Billings. For Roosevelt

County approximately $52,000 in inpatient revenues could potentially be retained at Roosevelt County Memorial Hospital and Nursing Home, and approximately $62,000 in outpatient expenses could be saved based upon mileage, wages and lodging.

Question. Has there been any indication of providers' willingness to use telemedical equipment?

Answer. The rural providers were initially most receptive to the concept. Urban providers had some reluctance both about the technology and about the ability to be reimbursed for telemedicine services. We are currently addressing the reimbursement of urban specialist physicians with a temporary, internal policy at Deaconess Medical Center and the Billings Clinic to palliate those concerns. As the project has begun to conduct telemedicine consultations, we have found the rural physicians to greet the technology enthusiastically. Urban physicians are becoming more responsive to requests for telemedicine consultations and we hope, as in other projects across the country, to build a sustainable physician complement for consultations.

Question. How do you use telemedicine in your institutions? In what ways has telemedicine reduced health costs, improved healthcare delivery, or increased efficiencies?

Answer. The full gamut of response to this question is currently under research in several centers utilizing telemedicine. However, one simple anecdote may help make a point. Recently, a patient from Glendive required extensive surgery and skin grafting to care for a leg wound. The surgery was performed in Billings by an orthopedic surgeon. Subsequently, the patient's primary physician in Glendive was able to manage her post-op and follow-up care with the assistance and oversight of the surgeon in Billings by use of the telemedicine system. At regular intervals, the patient was viewed by the surgeon in Billings, and slides of the skin graft were transmitted over the videoconferencing system so that the surgeon could follow up on his patient's post-operative healing. Discussion between the surgeon and the primary physician in Glendive, facilitated over the system, allowed the primary physician to perform all the follow-up care. As a result, the patient did not have to return to Billings for post-operative checks and follow-up care for her surgical skin grafting. This is but one example of how telemedicine reduces costs, in this case patient-incurred travel; improves healthcare delivery and increased efficiencies by not requiring the patient to travel and by involving the patient's primary provider in her follow-up care.

Question. What is the cost of implementing telemedical capabilities, including all relevant elements such as computer hardware and software, cameras, transmission equipment, etc.? How do you finance the implementation and operations? Are they self-financed by the healthcare community or do you depend on government funding to any significant degree? Have we reached the point yet where, due to cost savings and efficiencies, telemedicine will pay for itself over time?

Answer. The approximate cost of implementing telemedicine systems is $80,000 to $100,000 per site. This includes basic videoconferencing equipment, network termination equipment, and some medical peripheral equipment. Initial capital expenditures currently are dependent upon institutional resources or grants from either federal grant programs or private foundations. The Rural Health Transition Grant Program and the REA Distance Learning and Medical Link Grant program, amongst others, are two federal programs that specifically would provide money for the acquisition of equipment to implement a telemedicine network. For the smallest medical facilities, it is entirely likely that the initial capital expenditure will continue to have to be from grant sources. We believe that by building a broad user base within rural communities to include non-medical and users, ongoing operational costs can be offset by regular user fees. We estimate that approximately $100.00 per hour charge for the use -f a telemedicine site, over the long run, would pay for the ongoing operational costs of personnel and network.

Question. What are the most memorable success stories involving the use of telemedicine on your patients and/or customers? Since we are accustomed to hands-on medical treatment, are some patients skeptical about receiving telemedically delivered healthcare, and if so, how do you overcome that distrust?

Answer. As we have relatively limited experience, having just started our telemedicine project in Montana, the anecdotes about patient interactions are relatively limited. That described in response to a previous question, however, is an example. We have conducted approximately half a dozen telemedicine consults, to date. Another success story was that of an 18-month-old child with a body rash that the patient's primary care provider was unable to identify. We conducted a telemedicine consult with the patient and his physician in Culbertson, and a dermatologist in Billings, 320 miles away. The images transferred via the videoconferencing system were of high quality and the dermatologist diagnosed the

rash with 98 percent confidence and was subsequently able to convey to the patient's physician in Culbertson the appropriate management. The dermatologist was also able to convey directly to the patient's parents the nature of the rash, it's probably cause, and it's management. This saved the 18-month-old child and his parents a 600 mile round trip to visit a dermatologist in Billings for the same information. It has been our experience, although somewhat limited, because of the savings in time and travel involved, as well as the relative expdiency with which their medical concerns can be addressed via telemedicine, that patients have relatively little or no skepticism about the services delivered by telemedicine. We anticipate that we certainly will encounter patients who have concerns or distrust of the system. One specific concern involves confidentiality. The patients' concerns have, on several occasions however, been put to rest with regards to the confidentiality issue once a full explanation of the technology is provided. It appears that, although some patients have concerns, the benefit to them and convenience of the system overcomes those concerns relatively quickly.

Question. What advice would you give to hospitals seeking to establish new telemedical systems in their communities or regions?

Answer. The basics include thorough research of the field, pursuing multiple contacts. Costs of implementation can be balanced against time. The more quickly a facility wishes to implement a program, the more money they must be willing to spend. Certainly, there are individual companies within the industry who can provide turnkey videoconferencing systems, yet the integration of network services must be considered. Thorough research, multiple contacts, and patience in establishing the network are encouraged. Resources include the American Telemedicine Association, numerous videoconferencing equipment vendors, and numerous system integrators. Typical barriers include physician and lay community misunderstanding or lack of understanding of the technology and it's capabilities. We found it was most effective to demonstrate the technology to the providers and patients in the rural communities, rather than to talk to them about it or to show a videotape. The technology, frankly, sells itself when providers as well as patients and other potential end users are given the opportunity to experience the technology first hand.

Question. What cultural, technical and regulatory barriers do you face in your telemedical operations?

Answer. Cultural barriers are relatively limited except as described above. Technical barriers include the limited infrastructure currently available for band-with on demand, telecommunications services. Regulatory barriers specifically relate to reimbursement for telemedicine services by federal entities such as the Health Care Financing Administration and the Medicare program. Potential regulatory barriers include the licensing of providers who provide services across state lines. However, the reimbursement issue is the single greatest barrier to the implementation of this technology on a large scale.

Question. How can Congress and the Executive Branch most effectively support the development and use of telemedicine? What are some of the major policy issues that we in Congress should be addressing in this area and do any of those issues require new federal legislation?

Answer. The single greatest federal action could be to endorse the use and implementation of telemedicine as is currently being pursued with several grant programs previously mentioned. However, it is contradictory for federal grant programs to provide money to implement this technology while federal entities such as Medicare do not reimburse for the services over the technology they've funded. Therefore, Congress should undertake implementation of policy as well as regulations that would allow for Medicare reimbursement of telemedicine services. This is currently being pursued by HCFA, but a relatively slow pace is described by those most intimately involved in telemedicine services. Escalating the degree of activity and the pace of resolution of this conflict through Congressional assistance and guidance should be considered.

Question. In your view, what does the future hold for the telemedicine movement?

Answer. At this point, given the relatively favorable consideration of telemedicine services by members of this committee as well as members of the administration's Health Care Reform Task Force, it would appear that telemedicine services are going to be expanding in their scope and capabilities through the next decade, in all likelihood. The quality, as well as the scope of services delivered over the technology, is improving monthly. The cost of equipment and telecommunications services is anticipated to continue to decrease. It is believed that acceptance of telemedicine services by patients is not a barrier, and by providers will improve as does the technology. The single greatest barrier is reimbursement for these services which, when fully resolved, I believe will allow broad and rapid expansion of telemedicine projects and services across the country. It truly is a technological solu-

tion to the current issues surrounding geographic barriers to accessing healthcare. It's implementation in the healthcare arena in rural communities we believe will significantly enhance other services available in the communities, as well and this technology, along with other telecommunications technologies, we believe has a long-standing and important future in the evolution of the way medical and other services are delivered across this country.

LETTER FROM MARILYN S. CADE, GOVERNMENT AFFAIRS, TECHNOLOGY/ INFRASTRUCTURE, AT&T

SEPTEMBER 9, 1993,

The Honorable CONRAD BURNS,
U.S. Senate,
Washington, DC 20510–6125

DEAR SENATOR BURNS: Thank you for the opportunity to respond to your further interest in our views on telemedicine as follow up to our testimony before the Senate Subcommittee on Science, Technology, and Space.

The National Healthcare Industry Consortium (NHIC), is an emerging consortium of leading healthcare information management firms, working in collaboration with innovative healthcare providers, employers, insurers, government agencies and other parties in 14 communities across the country, which have come together in response to the ARPA TRP, to begin to define a new national healthcare information infrastructure, which will support a new approach to how information is gathered, managed, and utilized throughout the healthcare system.

The challenge is to create new healthcare information network systems that are 1) standards based 2) provide repositories of administrative and clinical data for outcomes research and clinical decision support 3) establish easy interoperability among systems used by hospitals, physicians, health insurers, government and others, and support ubiquitous access wherever it is needed.

We see telemedicine as one of the very important applications which can be a part of the solution in our efforts as a nation to improve how healthcare is delivered, lower its costs, and improve its quality and outcome.

Since the NHIC represents an emerging consortium of companies who agreed to work together to advance the development of a reference architecture in response to the ARPA TRP, we have agreed not to take a position on public policy issues, as a Consortium, which are beyond the purpose of our work together.

Thank you for the opportunity to respond to your further questions on telemedicine.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY MS. CADE

Question. Telemedicine is used to describe a fairly broad range of healthcare applications of computer and communications technologies How would you define "telemedicine," and what healthcare technologies (e.g., broad-band networking and 3-D computer imagery) would you place under that definition?

Answer. The National Healthcare Industry Consortium (NHIC) members have agreed, for purposes of our work together to use a fairly broad definition for "telemedicine". Telemedicine is a combination of telephony, computers, and video communications that can support clinical medical decisions, continuing education, and medical consultation with experts (laboratory technicians, radiologists, pathologists, physical therapists), and electronic resources, (such as the National Library's MEDLine) located in distant locations.

In short, telemedicine reduces the distance and time factors of providing information to remote locations. Telemedicine can be as simple and ubiquitously available as regular telephone communications where consultation is based on exchange of verbal information; this voice communication can be augmented by graphics or text; and finally, the communication can be extended into the interactive two-way audio/ one way video or into two way audio/video transmission.

Telemedicine also includes any live, interactive exchange of information and knowledge between physician and patient, or between physician and physician, or between other qualified healthcare professionals and patient and/or physician. Telemedicine can be used to provide information to supplement clinical decisions; to provide consultation in radiology and pathology; to provide continuing education; and to monitor and treat patients in their homes.

Systems vary in levels of complexity, but can include:

1) communications technology: satellite, microwave, fiber-optic lines, copper cables, specially treated copper cable/coax, wireless/cellular

2) computers/applications and video systems/software: low end personal computers and lap tops, facsimile machines; workstations and higher end computer systems; CODEC/camera/microphone/speaker and monitors; specialized medical instrumentation, including hand held scanning devices, microscopes, etc.

3) users who must become familiar with the capabilities of the system and incorporate its use into the delivery of medicine, including healthcare practitioners, nurses, laboratory technologists/pathologists; medical librarians, physicians.

The equipment which best suits a particular application varies widely—remote video consultation to support clinical decisions requires the highest level of visual quality while a video conference which is largely verbal in nature can utilize videoconferencing available today for business purposes. The particular application or use of telemedicine dictates the type of communications technology and equipment which is optimal to support the application.

For a more extensive discussion of telemedicine technology, The Telemedicine Handbook: Improving Healthcare with Interactive Video, by Dr. Jane Preston, Telemedical Interactive Consultative Services, Inc. published in 1993, provides an excellent discussion of technology.

Question. What are the most promising telemedical applications in the diagnostic treatment of patients and the data management of healthcare information? What is the state of the art in diagnostic telemedicine, particularly regarding interactive capabilities? In hospitals equipped to practice telemedicine, what are the more conventional uses of telemedicine?

Answer. Healthcare, as an enterprise, lags behind most other industry sectors in the integration of information technology in both clinical and administration areas to address cost and access. Few other systems are as complex as healthcare delivery, administration, and management. Today's existing information systems are generally proprietary in nature; information is largely gathered in handwritten notes, or conveyed to other caregivers in verbal form. Most common is the segregated system which does an optimal job of managing a particular application—such as laboratory, billing/claims submission, drug interaction, to name only a few. Rarely is information gathered in digital form at the point of encounter with the patient. Typically, the patient travels to the location of the physician or specialty clinic where information is gathered and retained. Little ability to access that information by a referring physician or consulting specialists exists. Standards for information exchange across both financial and clinical systems are very limited in existence and acceptance today.

NHIC's members recognize, through their presence as industry providers in healthcare, that there are substantive challenges to address in the area of technology adoption and integration across the entire enterprise, as well as in the continued development of new, enhanced technologies, including voice to text conversion, continued development of the algorithms needed to support visualization/virtual reality; enhancements in video/graphics capabilities for low-end devices; compression technology; light-weight/high performance batteries. However, the greatest challenges lie not in the development of new technologies, but in the creation of a standards based reference architecture which will provide a framework for the exchange of information across the various domains of healthcare delivery and in the ability to establish effective testbeds which help to establish best practices and proof of concept in the effectiveness of information technology in improving the delivery of healthcare access and in reduction of unnecessary expenditures.

Over the past few years, fairly extensive demonstration projects conducted by both private industry and by a variety of government entities, have been underway, and the results indicate that telemedicine can play a major role in reducing costs and improving decision making in both clinical and management areas.

In the area of high performance computing and communications, promising applications include telepathology, teleradiology; remote medical education/distance learning; interactive remote consultation with specialists, and telepresence which allows the remote specialist to view images and manipulate devices and images as though they were located physically at the remote location.

According to the National Rural Health Association, 28 percent of all rural counties have a shortage of health professionals. Many communities have no doctors—some of our states face extreme challenges in getting care into remote areas due to the lengthy car travel needed to travel. Many residents travel more than one hour to see a doctor—in areas which lack public transportation. It is not atypical to talk to residents of some of our states who describe 3-5 hour car trips to seek medical care from a primary care physician.

Many physicians avoid residencies in areas without resources—citing isolation from professional colleagues or medical support systems and libraries as barriers to

consideration of rural practice. And this condition is not limited to rural areas; practice in inner city or extremely poor urban areas are actually often very similar.

Of significant contribution already are applications which utilize today's technology in new ways in support of access to information; for instance, providing a link between physicians and the hospitals or clinics where they treat/refer patients, allowing them access to patient records, test results, and other healthcare practitioners to support clinical decision making, update medical records, record treatment notes.

Another application of immense importance is access to research data such as that provided by the NLM MEDLine, utilizing standard available products and services—fax, switched access lines; personal computers, and simple to use software to access the data repositories which store hundreds of thousands of medical articles. While this seems like a simple example, the impact of access to critical reference information which may change or support a diagnosis is of extreme value to the life of the patient—and to reducing overall cost through ensuring accurate and timely treatment.

As with most services of this nature, more work needs to be done in creating easy to use interfaces, training the professionals to use the system, and ensuring that it is moving into the arena of high performance computing and communications, adding new multimedia capabilities, etc.

One application which has received fairly wide acceptance in commercial business environments but is only now receiving acceptance in healthcare is electronic mail between consulting and referring physicians, physicians and other healthcare professionals (therapists, home health aides, etc.).

Remote physical examinations are a fairly recent, and specialized area of telemedicine which is still in need of much exploration and research but which seems to hold great promise for extending the physician into remote and isolated locations.

More familiar, and well established, is the use of telemedicine to provide remote consultation on laboratory tests, radiology and pathology results: Electronic imaging support is becoming fairly well established in large teaching hospitals and is now being utilized in other areas.

Also, telemedicine technologies have been used for several years to support "electronic Grand Rounds" between urban/inner city hospitals in New York City, and between teaching hospitals and remote rural hospitals,

Separate from telemedicine applications, electronic data exchange (EDI) used to exchange text forms of information, including lab results, pathology reports; electronic claims; medical information/patient data, is emerging as a key means of supporting information exchange. EDI is not interactive, and typically will not be included in the definition on telemedicine, but should not be overlooked as a key component of the full suite of technologies available to address healthcare's need for better utilization of information technology.

Hospitals are only now evaluating the effectiveness of telemedicine as an extension to bringing the professional to the patient—those hospitals which are equipped to use telemedicine are most frequently using telemedicine to enhance the delivery of continuing medical education, utilizing one way video, two way or multi-point audio.

Question. What types of diagnoses lend themselves most easily to telemedicine and what factors determine whether telemedicine is appropriate in a particular case or type of treatment? For example, I understand that telemedicine is particularly effective in administering physical therapy to those with disabilities.

Answer. In many ways the uses of telemedicine in real time diagnosis is fairly new; the more traditional and well accepted uses involve exchanges of information between specialists or a referring physician and a specialist located in different locations and support of a preliminary diagnosis. Much additional work needs to be done to identify where information technology can be effectively utilized to advance clinical diagnosis.

In the work defined by the proposal the NHIC submitted to ARPA, we identified the need to establish documented trials and tests of how technology advances both clinical and management decisions. Today, while much of the information technology exists, healthcare lacks a coherent and consistent architecture which allows easy incorporation of technology in the various clinical areas. Practitioners are unfamiliar with technology, or fear that it will remove their autonomy in patient treatment, or find it cumbersome to utilize or invasive of the patient/physician relationship.

The use of telemedicine in clinical diagnosis requires the highest quality technology (communications/computers/software applications/video) and physicians who are comfortable with the use of technology, and the changes in patient/physician

interaction which are needed to allow the use of a remote interaction. Much of the effectiveness is dependent upon the physician's ability to communicate via this technology; the project proposed by the ARPA TRP establishing a reference architecture, and funding several regional test-beds will provide the standards to allow uniform quality exchange of multimedia data and will accelerate their use in actual settings.

Certain types of interactions will probably always be most effective when face to face communications is available or simulated via video-conferencing. In some cases, physical interaction or guidance of the patient is needed—while it seems logical that in these cases telemedicine is not the optimal choice, in recent work by the Mayo Clinic utilizing telemedicine for remote diagnosis/consultation, "guided" examinations, where the remote specialists directs an examination by a physician or healthcare practitioner via interactive video, are producing excellent results. More research is needed to determine whether the diagnosis is actually changed by the use of technology to extend access to the specialist.

Some exciting new research results are becoming available which indicate that through the use of compression algorithms, existing technologies, such as today's versions of higher end personal computers and workstations, and communications services, such as standard T-1, can be used in the radiology and pathology image telemedicine, thus indicating that telemedicine may actually be much more used in diagnosis in teleradiology and telepathology than was once accepted. Certainly further testing and outcomes measurements are needed, and are called for in both the ARPA TRP program design, and in the HPCCI program as presently defined.

Question. How is telemedicine used to examine skin lesions and other health problems and ailments? How effective is telemedicine in recording patients, breathing and heart beat, viewing internal orifices, and obtaining brainwave information?

The use of telemedicine to examine skin lesions, recording patient's breathing and heart beats, viewing internal orifices, and obtaining brainwave information are all dependent upon the state of the technology, the training and availability of a trained technician with the patient to utilize and manipulate the devices used in examining the patient. Limited amounts of the technology needed to support remote examinations are available; but of even greater concern is the need for training in the use of technology in conducting remote examinations.

A major outcome of the projects proposed by ARPA and which our consortium has proposed, will be definitions of requirements, toolkits, interoperable standards to reduce the risk of building technology or solutions will not interoperate.

Question. Telemedicine can provide dramatic breakthroughs in the collection and retrieval of medical records and related administrative data. It is estimated that U.S. healthcare costs could be trimmed by $36 billion by the application of computer technologies to such areas as: (a) the management and transfer of patient information; (b) the electronic submission and processing of healthcare claims; (c) electronic inventory of hospital supplies, and (d) video conferencing for professional training and remote consultation. How can telemedicine reduce costs in each of these areas? To what extent is the healthcare community taking advantage of telemedicine to provide more cost-effective data collection, transfer, and retrieval?

Answer. (a) The creation of electronic medical records offers the opportunity for each and every U.S. citizen to have a lifetime medical record. Portions of an electronic medical record could exist wherever healthcare services were rendered. Through the use of smart card technology and a networked directory service, all occurrences of healthcare services rendered could be permanently and securely stored. When needed, any portion of or a complete lifetime view of an individual's medical record could be assembled as part of the healthcare delivery process. This could dramatically reduce healthcare costs by allowing for increased emphasis and management to preventative healthcare. An individual's health record could be continually reviewed by providers and computer augmented analyses performed to detect trends. In other words, even though at any point in time results from a routine examination may in the normal range, the tracking of "normal" results over a period of time may indicate a trend leading towards an abnormality, and early preventative treatment could be administered thereby avoiding costly illness. The electronic medical record would allow physicians to access and share a patient's medical history anywhere, anytime. For example, a referring physician and one or more medical specialist experts could confer over a patient's medical data to reach a joint decision on treatment. Network transmission of all relevant data could be transmitted to all of the involved physicians under secure access provisions. All physicians would view the same data, thereby achieving consistency. Ad hoc repetition of tests would be eliminated, reducing costs. The span of medical knowledge would be increased, and patients would not necessarily be limited to the medical knowledge of a geographic area. This could introduce an extra competitive element between healthcare providers and contribute to lower costs through lower toes. Economies of scale could

contribute to lower costs and improved healthcare quality by allowing for centers of specialization and excellence. These centers could be provided with electronic medical record data for patients anywhere in the U.S. Expert diagnoses could be made. As is well known, in many instances the accuracy of a diagnosis is directly related to the number of symptom/disease occurrences experienced by a physician, Centers of specialization and excellence would review many more cases and therefore achieve a higher accuracy of diagnosis.

. Electronic medical records would allow for the macro analysis of utilization review and outcomes analysis of healthcare providers. This would contribute to the efficiency and effectiveness of healthcare providers and keep costs down.

Answer. (b) The electronic submission and processing of healthcare claims would neatly reduce manual paper-based processing thereby achieving reduced labor costs. More importantly however, is the tighter coupling that elimination of paper-based processing offers in the management of the healthcare system, which could yield significant Improvements in efficiency and effectiveness. Electronic eligibility verification would immediately let patient and physician be aware of coverage entitlements. Precortifloation based upon initial diagnosis/prescribed treatment would give payer entities some participation in the treatment decision prior to proceeding. This should eliminate excessive testing and over treatment. Claim adjudication and coordination of benefits could be automated with the application of "expert system" computer technology. Financial transactions could be made electronically through the existing electronic funds networks. This would also eliminate paper and manual posting of payments.

Electronic healthcare transactions will help reduce administrative and clinical costs associated with managed care plans such as HMOs and PPOS. These types of plans place the financial responsibility on the healthcare provider to contain costs. As a rule, managed care plans require a much closer coordination and tracking as part of healthcare services delivery. Electronic healthcare transactions will blow for much tighter process control in the delivery of healthcare.

Answer. (c) Hospitals can learn much from other industries such as manufacturing in controlling costs by tighter inventory control through the use of on-line inventory control systems, automated demand forecasting of supplies, and electronic ordering of supplies by the use of electronic data interchange (EDI). Reductions in excessive shelf inventory and the cash tied up in excessive inventory can allow hospitals to realize dramatic cost savings. In addition, on-line electronic inventory systems will enable hospitals to track the usage of supplies in real-time, and provide audit trails on consumption by department, person, etc. This will contribute greatly to reductions in the mysterious loss of supplies.

Answer. (d) Video conferencing can be used in conjunction with the sharing of electronic medical records data discussed in (a). Video conferencing expands the scope of influence of healthcare specialists and experts by allowing them to share their knowledge and expertise with healthcare providers wherever they may be located. Educational training may be extended over long distances without travel, Treatment techniques, surgical techniques, etc. may be demonstrated to large healthcare provider audiences over long distances. These types of services are of particular importance to healthcare providers located in more rural settings. No longer will these areas suffer from lack of access to medical knowledge and expertise. Many more physicians may be motivated to locate in more remote parts of the U.S. with the assurance that access to high tech medical expertise is easily available through video conferencing.

Question. To what extent is the healthcare community taking advantage of telemedicine to provide more cost-effective data collection, transfer, and retrieval?

Answer. It appears that the healthcare community is in the very early stages of using telemedicine for more cost-effective data collection, transfer and retrieval. Currently, only leading edge institutions and early adopter physicians are experimenting with information technologies such as telemedicine to reduce costs and improve the efficacy and quality of healthcare. The incentives have not been present to motivate the large majority of healthcare practitioners to adopt telemedicine. In addition, the healthcare provider community is very fragmented in Its requirements for the application of technologies like the electronic medical record. A consensus does not currently exist. Local government statutes also serve as an impediment by requiring paper-based healthcare records for reasons of security, confidentiality, and long-term storage. These statutes are not consistent with 1990s information systems technology, and healthcare providers cannot see overlaying electronic information technology on a paper-based system. This would only add to costs, not reduce them.

Question. What are some of the reasons why telemedicine has not enjoyed wider utilization in healthcare and data management? When an Individual hospital wants to develop telemedical capabilities, what are the main problems that it faces in

doing that, particularly in terms of costs, technology, and administrative and regulatory barriers? What steps can the federal government, the state governments, and the private healthcare industry take to lower some of the barriers to wider incorporation of telemedicine in the U.S. healthcare system?

Answer. In our testimony presented before the Subcommittee, the NHJC identified as the major challenge the need to change how information is gathered, processed, and distributed and used across the healthcare enterprise. The A.D. Little study, commissioned by eight telecommunications companies to explore the role of telecommunications technology, suggested that selected telecommunications applications can help to reduce today's costs.

Basic underlying assumptions of the study included the more effective integration of information, reduction in duplication of test and information gathering; elimination of travel costs and time for consulting specialists; reduction in inappropriate or unnecessary treatment. Telemedicine's most useful and effective impact on the quality of care comes from the ability to make resources available that are otherwise not available—extending the access to a specialist at the Mayo Clinic to aid in the treatment of a patient living in Washington, D.C. seems obvious; but extending that same availability of the specialist to a hospital in a small community in North Dakota, upper Maine, or Alaska makes the impact even more obvious.

The A.D. Little study suggested that almost $30 billion of the cost savings would come from changing the way patient information is gathered, managed, and shared. Assumptions include reductions in unnecessary visits to emergency rooms, doctors office and hospitals.

Our Consortium's proposal is based on the assumption that more work needs to be done to develop a unified and coherent architecture across the various sectors of the healthcare enterprise which allows efficient and accurate exchange of information. We believe it is especially useful and important to look at the outcome of the application of these technologies and their impact on reducing patient care costs, improving access to both preventative and critical care, and to supporting and improving the quality of care delivered. Such ongoing outcomes analysis efforts are not in existence today on a large scale basis, and we, sadly, lack much of the information we need to make some of the informed decisions. That makes the efforts called for in our Consortium's work effort, and other similar initiatives even more important to advance our understanding of how best to utilize information technology to address these challenges.

Question. Why hasn't telemedicine enjoyed wider utilization in healthcare and data management?

Answer. Significant policy barriers exists to the use of any system which is dependent upon access to digital information; concerns exists in relation to privacy and security, reimbursement from both governmental and private payers; lack of a coherent public policy on both a national and state level which supports the use of telemedicine as a component of the healthcare delivery system.

Another question which must be addressed is physician licensing. At least two states require that the physicians engaged in telemedicine be licensed in both the sending and receiving states. Reciprocity agreements between states represent "work arounds", but are not an entirely satisfactory solution. The same questions arise in the ability to fill prescriptions written in one state but transmitted electronically to another.

Liability is a major concern to the physician engaged in telemedical diagnosis, and it is our view that technology itself is not the only issue in this area. We believe that test-beds, such as the ARPA TRP supported program describes, are a critical component of creating "best practices", and in determining when telemedical diagnosis is both appropriate, and under what circumstances, a useful alternative to patient travel. The physician is always the judge of when he/she has enough information to make a diagnosis, and the role of telemedical services is to support providing that information, not replace the need for it. Telemedical services should be used to augment access to information for the physician, by providing access to additional information, or knowledge sources, such as data bases, or specialists.

Question. What is the federal government currently doing to support the development and implementation of telemedicine in the U.S.? What portion of the billion-dollar High Performance Computing and Communications initiative is devoted to telemedical research? To promote the development of telemedicine, which technologies should receive the most federal support?

Answer. Dr. Don Lindberg, Director, National Library of Medicine, spoke at the hearing about activities underway at the National Library of Medicine. The specific details on what expenditures are underway, or planned, will undoubtedly be provided by his office in response to the questions. In our response to the ARPA TRP, our emerging Consortium noted that the proposed approach of TRP called for creat-

ing a reference architecture which will allow better and more rapid incorporation of standards based technologies into application areas, such as healthcare. Some of the Grand Challenges fLnding from HPCCI has benefited healthcare through supporting the more rapid development of underlying technologies in high performance and communications—including the technologies to support gigabit testbeds; software algorithms, compression algorithms. VISTANET, one of the gigabit testbeds, was highlighted at the hearing as an example of how high performance computing, and the associated technologies were applied in an experimental design which has resulted in a phenomenal breakthrough in treatment. Other examples of these applications of emerging technologies exist in the other aspects of the HPCCI Program.

As important as technologies are, and as much as they should continue, our Consortium's membership is concerned that today's technologies, and their capabilities are not being applied as rapidly as possible to address the problems of access and cost in delivery and management of healthcare. Through our ARPA TRP response, we call for support for extensive broad scale demonstration projects utilizing existing legagy systems, and integrating new technology, but focused on the development of an agreed upon set of standards which lead to the development of an architecture across diverse systems. In essence, we are calling for the creation of an architecture which can span different systems, and which will lead to the use of open standards based technology. In our view, the program proposed by the ARPA TRP, as well as the proposed initiatives in healthcare described in 5.4, and the initiatives described in Dr. Lindbergh's testimony all represent worthwhile and important initiatives to address the development of a healthcare information infrastructure which is standards based, which supports the development and introduction of a new environment in healthcare delivery where information can be provided where it is need, when it is needed, cost effectively.

Telemedicine, which extends the knowledge and presence to where the patient is, rather than requiring the patient to be where the physician is, is especially dependent upon the use of a standards based architecture in software, computers, and communications.

Question. Several of the telemedical systems in the U.S. were started with the help of federal grants. However, others seemed to have naturally evolved in response to marketplace demands on the local healthcare community. Do we need federal grant programs to support funding for telemedical facilities or should the government concentrate mainly on supporting telemedical R&D?

Answer. It is still early in the stages of incorporating telemedicine technology into how healthcare is delivered; while existing research clearly demonstrates the benefits of providing information and expertise into remote areas, we still have much work to do in enhancing and incorporating technologies that are still in many cases only emerging into the commercial business type environment, but which seem to hold great promise in heathcare—including high definition full motion video over existing video, using emerging compression capabilities; developing and incorporating remote sensing devices, and microscopes which can be remotely manipulated; easy to use graphics; integrated text along with radiology and pathology, wireless access so that truly remote and mobile communications can be easily established on an ad hoc basis, and many more.

In some cases the technologies are either very new, or are not yet even tested in healthcare. In other cases, the integration of the technology requires extensive testing by healthcare practitioners to develop the kinds of applications which are truly enhancing to heathcare delivery. The government can play a very vital role in supporting, along with industry, further research in applying these technologies, can participate as a major funder, again along with industry of testbeds and large scale demonstrations which have defined programmatic outcomes, and which include a "technology" transfer component so that the state of the industry's knowledge is enhanced as a result of the government funding effort; finally, as a major supplier and under of healthcare delivery, the government must be an "adopter" of effective high performance technologies through the use of these technologies in their own systems.

Federal grant programs which put technologies in the hands of practitioners, tests its effectiveness, and advance how quickly technological solutions are incorporated into how healthcare is delivered are also critical aspects of advancing the agenda we are all concerned about—the delivery of better, more affordable healthcare to all Americans., regardless of where they live, or what their medical need.

Question. How does the quality of telemedically-delivered healthcare compare with that of "hands-on" medical treatment?

Answer. We see no clear answer to this question since the technologies are not widely enough deployed to have long standing outcomes anaylsis, comparing face to face with "telemedicine" treatment. In many cases, it will also be depending upon

how comfortable the practitioner is with the technology, and how comfortable the patient is with the situation. It is interesting to note that, unlike other markets, healthcare practitioners rarely send out "customer surveys" about satisfaction. We are seeing changes in that model, as our country examines concepts of managed competition, but we are also as citizens changing our expectations of what quality healthcare is and understanding our own need for more and better information about prevention, treatment, and outcomes.

But there is frankly a cultural side to this equation as well. when videophones were introduced many years ago, they received no acceptance—not because of cost, but because they were "uncomfortable"; they violated our cultural expectations for how to communicate. Today, we are seeing a very rapid emergence of videoconferencing as a support to communication; a lot has changed in the technology, but the greatest change is in our own familiarity with and acceptance of technology.

Quality is always a combination of what actually happens, and how it is perceived. In healthcare, there is also a factor of the impact on the outcome—was the "right" diagnosis reached; was it timely and cost effective.

Undoubtedly, the move to outcomes management will advance our general understanding of what quality is in face to face treatment, and can also extend into, and should be included in any system utilized in healthcare, including telemedicine.

Question. Telemedicine often involves video-conferencing, which may not provide the same degree of privacy and confidentiality as a doctor's office. How do you address the problems of maintaining privacy and confidentiality?

Answer. There are at least three considerations to the issues of privacy and confidentiality. The first is the source or point of origination of the conference—usually where the patient is located. The second is the transmission of the conference over a telecommunications network, and the third is the destination end. Video conferencing equipment, including cameras, displays and computer equipment for the management of patient electronic medical records has become sufficiently compact that a doctor's office setting is easy to duplicate. The perception of a large TV studio like environment that is not conducive to physical privacy is not accurate—given the state of today's technology and the technology which is rapidly moving into the commercial marketplace and is becoming available, and affordable. Very intimate and private conference settings can be provided at any location participating in a conference, thereby providing physical privacy. Telecommunications networks are capable of encrypting and decrypting transmissions in real time, and privacy of date, video, and voice can be easily, and affordably assured. Legitimate access to patient electronic medical records require or a conference can be assured through the use of smart card technology, similar to the approach utilized today with electronic access to financial records, utilizing a "pin", or other verification of right to access, putting control of the release of sensitive clinical information in the hands of the patient at the time of the conference.

While there is much anxiety about the ability of "hackers" to access digitized medical records, in actuality, the issues of protection of the privacy of a patient's medical information is much more vulnerable when it is paper form. That is not to say that these are not significant issues, but the technology available from industry today, which can be easily integrated into the healthcare systems, can ensure privacy.

Question. Many physicians will not provide healthcare on a remote basis because insurance companies will not pay for those services. Why won't some insurers pay for telemedical services? Are their concerns legitimate? How can the healthcare community address the insurers, unease with telemedicine?

Answer. Many of our laws and public policies do not reflect the changes in technology, and are in need of updating to reflect today's capabilities, and to take advantage of emerging capabilities. Telemedicine falls into that area. Physicians are typically, going to be influenced by what they are able to get reimbursed for, and we should expect that. When one of the largest insurers, the U.S. Government, hasn't yet fillly incorporated telemedicine into its reimbursement schemes, it is not surprising that the private insurers follow suit.

We think that the the concept of "best practices" and models or recommended uses can certainly be developed, and agreed upon reimbursement mechanisms put in place which address any concerns, and yet allow the utilization of telemedicine as it is useful, and appropriate to support healthcare delivery.

Question. It appears that most of the activities demonstrated here today are designed for use within a relatively local area. A concern arises over access to such services by low and moderate income residents in remote areas. Has work been done to look at the impact of providing such applications over long distances?

Answer. Healthcare is, today, delivered within what we think of as a local area; patients prefer to go to medical facilities/doctors that they have easy, and quick ac-

cess to. That is both easily understood, and common to most of us. The challenge which telemedicine has is not to replace the face to face treatment which is preferred when distance is no object, but how to extend resources that are today distant, into a remote area or distant area.

However, telemedicine will allow us to in some senses, change that dependency on the limitations of distance. Through telemedicine, the fact that the clinic with the consulting specialist is several thousand miles away is not a concern—the best available specialist can be made available when needed.

Question. What are the cost implications for providing such services? Who is the expected audience and can the majority of Americans pay for such services? Would the involvement of larger firms in the development, marketing, and provision of such services have an impact on costs?

Answer. The cost of the initial investment in the technology and establishing the communications connections represent only a portion of the costs in telemedicine. The increasing utilization of standards based, open systems technologies and communications which are provided via commercial services will continue to make the costs more affordable; however, no matter how much the costs drop, until the policy issue of insurance reimbursement for the use of telemedicine is addressed, telemedicine will not be a feasible alternative for most Americans. As companies see market opportunity, additional suppliers will emerge quickly.

As telemedicine becomes an accepted form of delivery, and a competitive market emerges, numerous additional options will emerge. In fact, many of the sophisticated providers of these services today are large firms; some of our own members are actively engaged in telemedicine or are patterned with other smaller companies who are providing such services and products.

Question. How does the deployment of such services interrelate to the use of transmission facilities? Will these applications require broadband distribution or will copper cable provide adequate quality for transmission? If the deployment of broadband transmission will assist in the deployment of these applications, how can Congress assist?

Answer. There is no one technology—either in communications or computers which will address all the needs for telemedicine. In fact, if we were to focus on broadband as a requirement, we would miss the emergence of wireless technology—a technology which promises to assist greatly in providing medical assistance/consultation in emergency situations. And we would also miss a very important challenge—significant work is needed in research and development in interfaces which are easy to use, which incorporate human intuitive communications capabilities into the application, in the development of new and smaller portable devices with lightweight batteries with longer life cycles; and many other areas.

Software compression algorithims are extending the capability of today's existing technology, while we rapidly move to broadband networks; ISDN and other services are receiving much acceptance in healthcare as more short term ways to introduce increased bandwidth.

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